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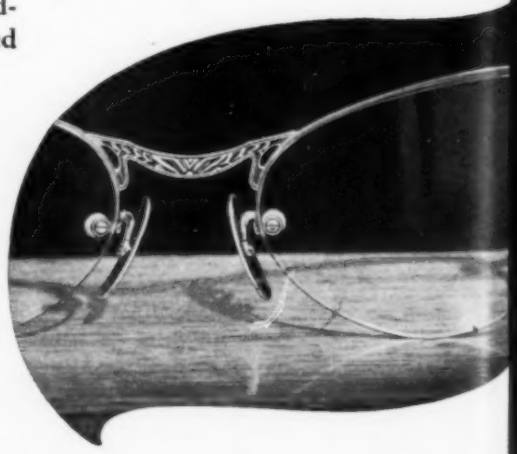

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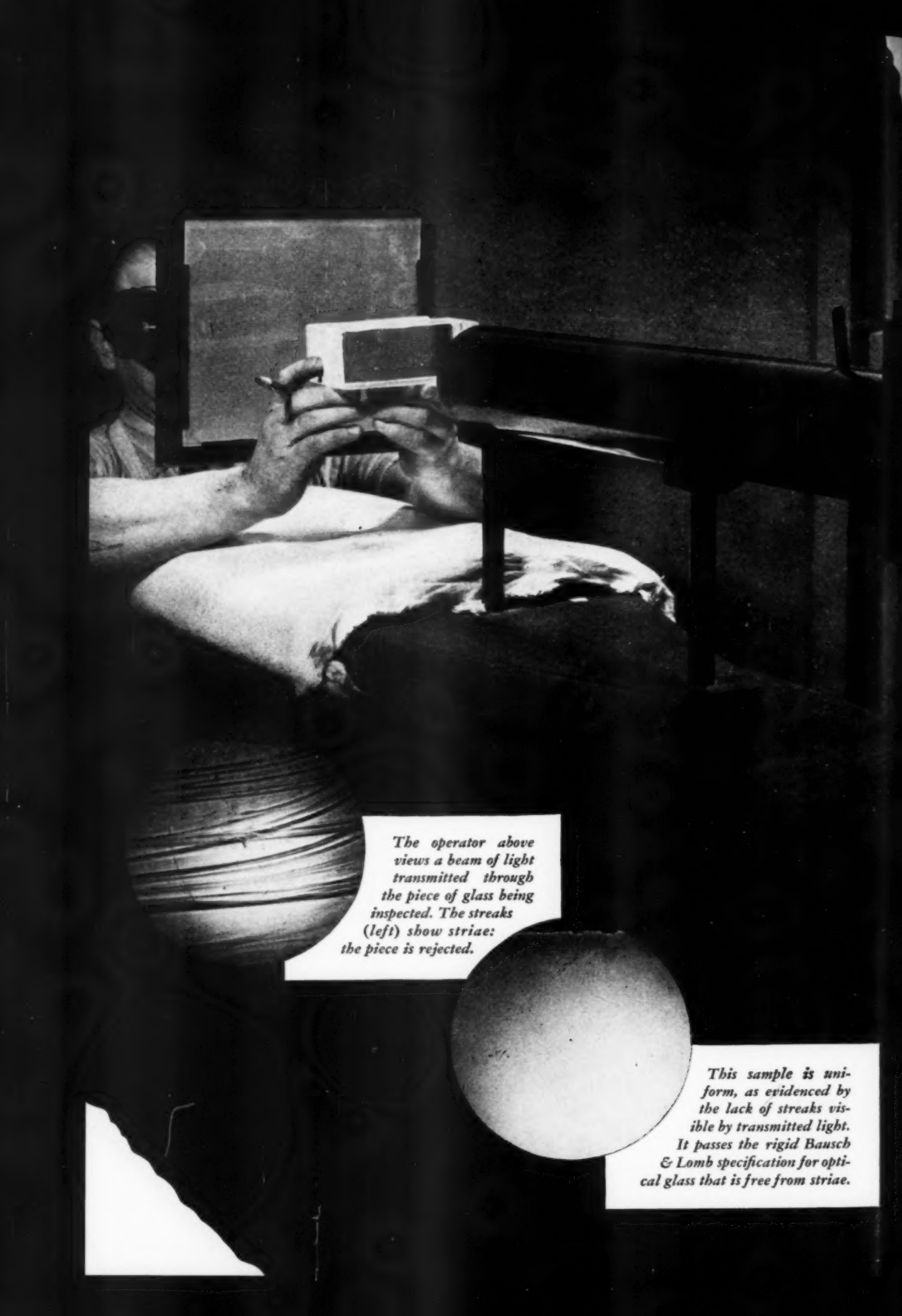

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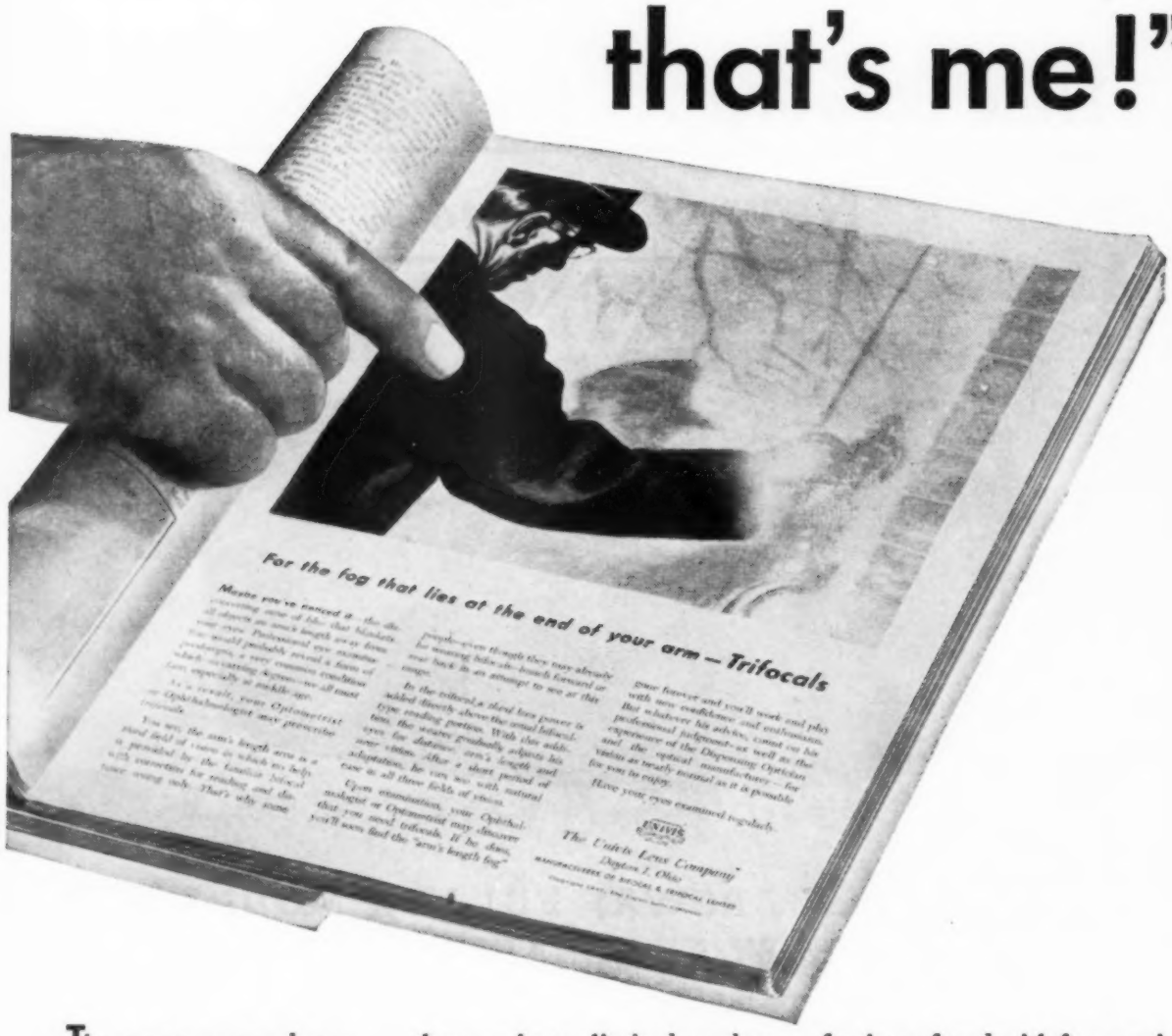

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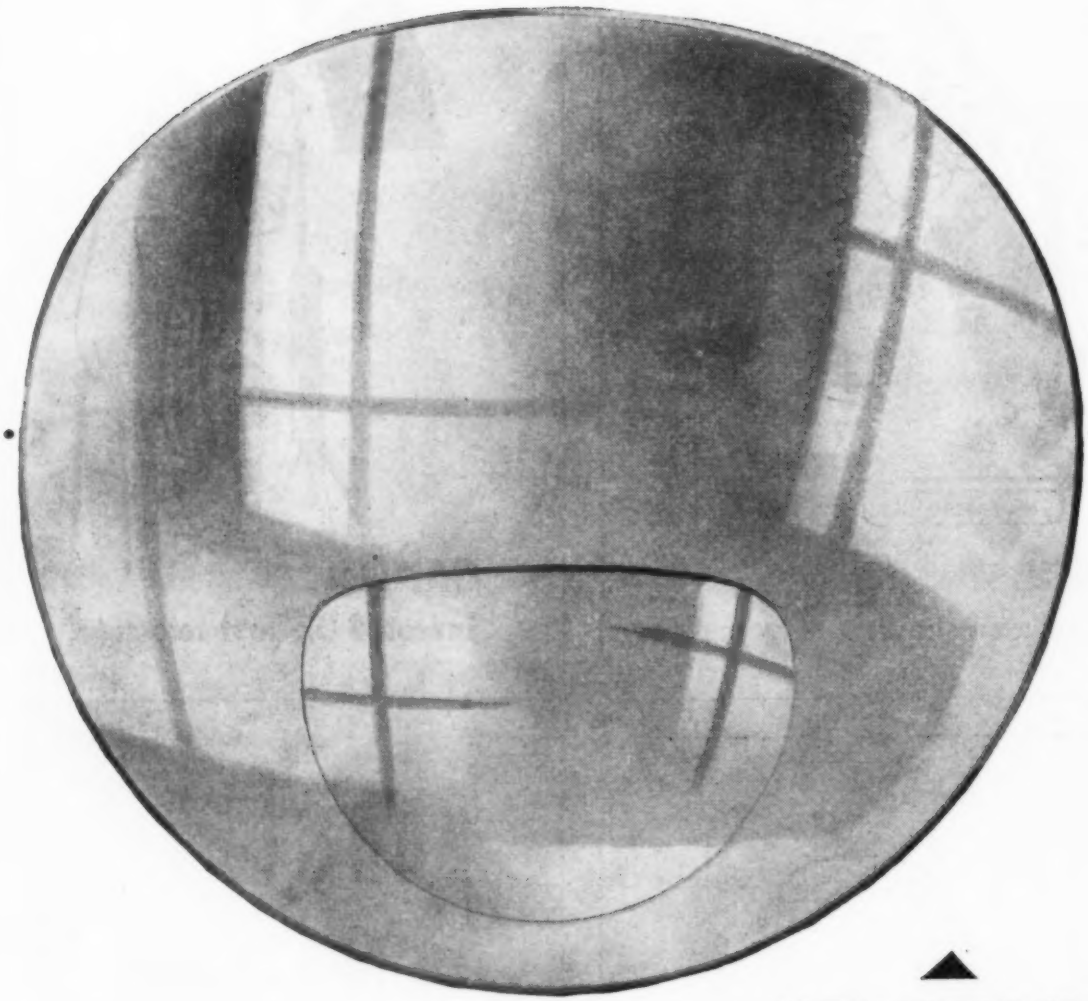

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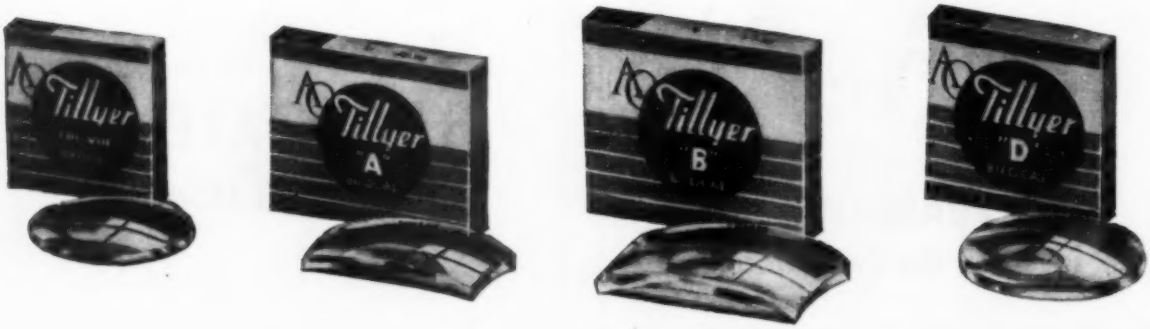

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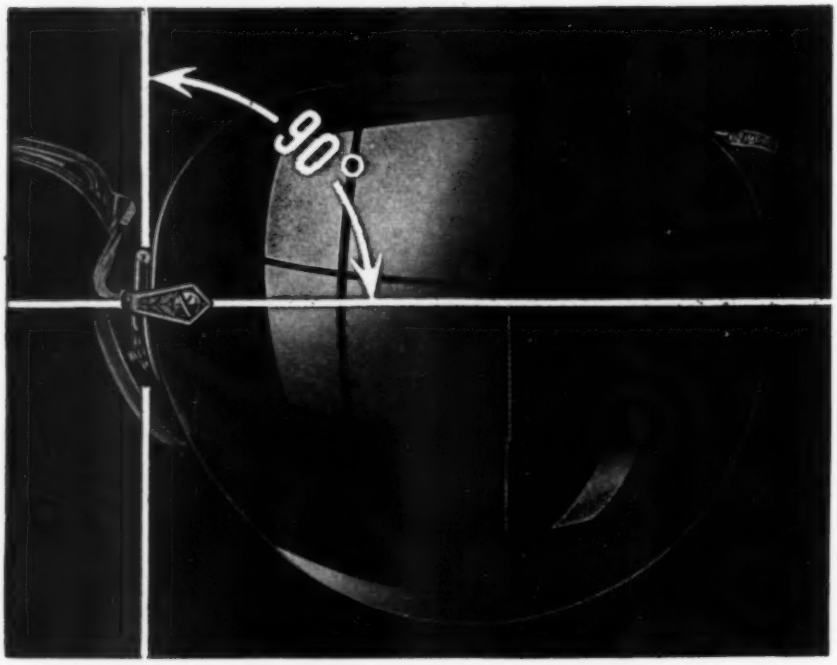

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Vol. 24 NOVEMBER, 1947 No. 11

THE USE OF CYCLOPLEGICS IN REFRACTION*

Robert E. Bannon†
Hanover, New Hampshire

I. Introduction
II. Historical Aspects of Mydriatics and Cycloplegics
III. The Pharmacology of Cycloplegics
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I. INTRODUCTION

Among those who are interested in the subject of refraction there has been, and perhaps always will be, considerable divergence of opinion relative to the need for cycloplegics. Many ophthalmologists who are ardent supporters of the use of cycloplegics have not familiarized themselves with the technique of measuring ametropia without a cycloplegic and have not investigated seriously the differences in refraction found with and without cycloplegia. Likewise, there are many optometrists who condemn the use of cycloplegics yet, in most instances, they have had little or no experience with cycloplegic refraction.

There has been a need for a controlled study on the use of cycloplegics in refraction, not only because of existing conflicting opinions but also to overcome a certain general lack of knowledge on a subject which influences the welfare of a class of patients that constitutes the bulk of both the ophthalmologists' and the optometrists' practices. Almost every patient who consults either the optometrist or the ophthalmologist requires a refractive examination. That both groups of practitioners, employing different means, have satisfied for many years the refractive needs of their respective patients indicates that there must be some merit to the technique peculiar to each group or else we must conclude that patients' refractive problems are solved irrespective of the

*An abridgment of the material presented before the annual meeting of the American Academy of Optometry, Philadelphia, Pennsylvania, May 18, 1947. For publication in the November, 1947 issue of the *AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY*.

†Optometrist. Fellow, American Academy of Optometry. Associate in Optometry, School of Optometry, Columbia University, New York, N. Y. Research Editor, Am. J. Optom. & Arch. Am. Acad. Optom. This study was completed at the Dartmouth Eye Institute, Hanover, New Hampshire, while the author was an Assistant Professor in Applied Physiological Optics at that institution. A grant-in-aid from the American Academy of Optometry was used toward the expense of clerical assistance and is hereby gratefully acknowledged.

clude that patients' refractive problems are solved irrespective of the means used.

The purpose of this study is not to instigate a crusade for or against the use of cycloplegics. The aim of this project has been to summarize the literature on the subject of cycloplegia and through careful refractive examinations of the same patients without and with the use of cycloplegia to obtain data for comparison and study. It is hoped that a presentation of this material will fill an educational need that seems to be definitely lacking to the ophthalmic professions.

The unique circumstances to make such a study as this are not easily duplicated in private practice or in any of the ophthalmic institutions. At the Dartmouth Eye Institute a group of ophthalmologists and optometrists cooperate on the examination of patients, and an excellent opportunity exists for the interchange of techniques and opinions. During the period 1940-1942, Walter B. Lancaster was chief of staff of the Dartmouth Eye Institute, and his great interest in, as well as profound knowledge of, the field of refraction resulted in many profitable discussions among the ophthalmological and optometric staff members. It was Dr. Lancaster's influence and the many discussions which occurred under his aegis that have inspired this study. But it should be pointed out that his views have not influenced the conclusions drawn from the data presented in this report.

II. HISTORICAL ASPECTS

Anyone who purports to be familiar with a certain subject should have some knowledge of its history. Most of those who have made statements on the subject of cycloplegia cannot answer intelligently the simple question as to when and by whom this method was discovered.

It is very interesting to note that Pliny[1] (23-79 A. D.) discourses on the use of mydriatics. He describes how, 1900 years ago, various herbs were used to dilate the pupil for treatment of cornea ulcers, in the operation for cataracts, and in other ocular affections. He does not, of course, mention the subject of refraction. It is obvious from the literature[2] that drugs of the atropine and/or similar families were used for over 1900 years for medicinal purposes, and during the sixteenth century mydriatics were used, especially by Italian women, for cosmetic purposes—hence, the term "belladonna." Besides dilating the pupil and giving the eye a bright glistening appearance, medieval women used the juice for the *atropine* herb to stain the skin. The generic name, atropine, came from Atropos, which according to mythology was the eldest Fate who cut the thread of life, since it was found that in sufficient quantity the herb produced a fatal toxic state.

It was not until 1811 that the cycloplegic effect of mydriatics was reported by William Charles Wells,[3] a London oculist. In 1809, Dr. Wells was consulted by a patient, age 35, who had dilated pupils, partial ptosis, and greatly diminished accommodation following an attack of catarrh. At first, Dr. Wells assumed that the dilated pupils were due to "a defect of sensibility in the retinas," but he was obliged to abandon this opinion when the patient assured him that the sensation of light was as strong as it had ever been during any former period of his life. Dr. Wells was particularly impressed that the patient could not see near objects distinctly whereas formerly he had had no such difficulty. It now required convex glasses to see clearly the pages of a printed book. Dr. Wells concluded that coincident with the dilation of the pupils and the paralysis of the upper eyelids, the patient

". . . had acquired the sight of an old man, by losing suddenly the command of the muscles, by which the eye is enabled to see near objects distinctly."

Dr. Wells indicated his knowledge of accommodation by stating:

". . . it being known to those, who are conversant with the facts relating to human vision, that the eye in its relaxed state is fitted for distant objects, and that the seeing of near objects accurately is dependent upon muscular exertion."

After considerable reflection, it occurred to Dr. Wells:

". . . as the juice of the herb belladonna, when applied to the eye, occasions the pupil to dilate considerably, and to become unalterable by light, an effect might at the same time be produced by it upon vision, similar to that which I have just described."

That is, Dr. Wells, impressed by the coincidence of dilated pupils and loss of accommodation in the patient he had seen, wondered if belladonna which dilated the pupils would also affect the accommodation. He resolved to test this possibility, but, since he was an elderly man and realized that his accommodation was deficient, he instructed a young physician, Dr. Cutting, to make the experiment. Having ascertained his range of vision by means of luminous points, Dr. Cutting applied juice of belladonna to his left eye. From the data given, it is clear that prior to the instillation of belladonna, Dr. Cutting had about seven diopters of accommodation in his left eye. One-half hour after the instillation of belladonna, his accommodation was about six diopters and in forty-five minutes it was slightly less than one diopter. When the pupil had attained maximum dilation, his accommodation was less than one-half diopter. This loss of accommodation continued for twenty-four hours and it was not until eight days later ". . . that he completely recovered the power of adapting his eye to near objects." While Dr. Cutting's left eye, the one treated with belladonna, lost the power of accommodation as described above, the vision of the right eye remained unaltered.

Since this was the *first time* that belladonna had been used as a

cycloplegic, Dr. Wells had Dr. Cutting repeat the experiment on his other eye and the results were the same. Despite the fact that Dr. Wells discovered the cycloplegic effect of belladonna, he was as much, if not more, impressed with another phenomenon which occurred during Dr. Cutting's experiments. This second observation had to do with the recession of the far point, (as well as the near point), while the eye was affected by the belladonna. In its normal state Dr. Cutting's eye was apparently slightly myopic and under the influence of belladonna it became slightly hyperopic. That Dr. Wells considered this phenomenon significant is shown by his statement:

"Being now in possession of a new instrument, I next attempted to gain, by means of it, some illustration of the changes, which the vision of short-sighted persons undergoes from age."

Dr. Wells proceeded to use belladonna in the eyes of a few myopic subjects and he mentioned that in all cases the power of seeing near objects clearly was abolished. However, the effect of the belladonna upon the extension of the far point of distinct vision was not consistent in the few cases with which he experimented. Dr. Wells also pointed out various hypotheses regarding the consensuality of the pupillary reactions and also the effect of the external muscles on accommodation and convergence that could be adduced by the use of belladonna. However, interesting as the further points are, it is sufficient for the purposes of this paper to show that it was Dr. Wells, in 1811, who first demonstrated the cycloplegic effect of belladonna.

Numerous other investigators (MacKenzie, von Graefe, Helmholtz, etc.) soon followed Wells and Cutting, but it remained for Donders (1864) to make many experiments himself on the effects of atropine and to stimulate the use of cycloplegics in routine refraction. Prior to Donders' time very little attention was given to the correction of refractive anomalies, and it was not until Donders' textbook[4] appeared that refractive problems were scientifically considered. To be sure, spectacles were available before that time, but these were fitted for the most part by the purchasers themselves, who selected the spectacles with which they could see best.[5]

The use of cycloplegics was universally accepted following Donders' definition of "refraction" and the techniques that he advocated. Donders wrote:[4]

"*By refraction of the eye*, we understand its refraction in the state of rest; that is, the refraction which the eye possesses in virtue of its form and of that of its component parts, independently of muscular action, independently of accommodation. The term, therefore, applies to the refraction of the eye whose muscles of accommodation are inactive or paralyzed (for example, under the influence of atropia)."

The next important contribution to the field of refraction was Landolt[6] whose "The Refraction and Accommodation of the Eye and their Anomalies," was published in English in 1886. He wrote:

". . . in order to determine the static refraction of the eye, the accommodation must be excluded; otherwise, the dynamic being added to the static refraction, we shall not find the *punctum remotum*, but a nearer point" . . . "To insure a state of rest for the eye, the accommodation must be paralysed by a mydriatic, such as atropine, duboisine or homatropine."

Landolt devoted many pages to a comprehensive review of the history, pharmacology, and various forms of mydriatics as well as miotics.

There is considerable evidence[7] from the early ophthalmological journals of this country that the orthodox method of refraction entailed the use of a cycloplegic. Progress was made slowly, but definitely, in the sense that several ophthalmologists experimented with various forms of cycloplegics in an effort to find one which gave satisfactory paralysis of accommodation, but whose effect wore off quickly. In the latter part of the last century, the current arguments concerned the use of homatropine in place of atropine. As an example, Julian J. Chisholm[8] wrote in the American Journal of Ophthalmology, 1891, regarding "Homatropia in Refractive Cases":

"Since 1883, I have been using homatropia with such steadily increasing confidence that I now rarely use anything else." . . . "Judging from the entire satisfaction which homatropia gives me in my refractive work, I consider a physician culpable who robs a working man or sewing woman of a week's daily bread through his preference for the more persistent atropia."

At the beginning of the present century, ophthalmologists began to consider that refractive examinations might be done without the aid of a cycloplegic. Lucien Howe[9] in his book "Muscles of the Eye," 1908, writes:

"As to the necessity of using cycloplegics in order to de ermine the refraction, the differences of opinion are more apparent than real. On the one hand, we have the optician's experience that cycloplegics are unnecessary—probably because he is prohibited in most countries from using them. But his experience in correcting errors of refraction is often so great that we cannot honestly ignore his testimony. Moreover, patients constantly bring from the opticians glasses which have given perfect satisfaction for a long time.

"In many clinics, especially in Europe, where the number of patients is large and the cases of ametropia are usually dealt with more superficially than here, we often find very good results obtained without cycloplegics.

"Finally, there are theoretical objections to their use. Our aim is to test the condition of the eyes as they are in action, not as they are when artificially at rest, and, moreover, we do not need to know the refraction of the parts of the lens which are normally covered by the iris.

"On the other hand, it will be admitted as beyond the question that the full dose of cycloplegic does furnish additional data, especially as to the amount of a suspected hypermetropia or hypermetropic astigmatism. It will also be admitted that in most cases when the suffering from persistent pain is considerable, it is desirable to obtain all the data possible. The arguments for and against cycloplegics can be summed up by saying that while it is possible to obtain an accurate and satisfactory correction of the ametropia without a cycloplegic, it is certainly more difficult to do so than with

its assistance, and taking into account the inconvenience to the patient, it is simply a matter of judgment in each case whether its use should be advised or not. The practice of invariably resorting to a cycloplegic is as reprehensible as not to use it at all. The question must be determined by the peculiarities in each case, by the degree and persistence of the symptoms, by the occupation of the individual, and the inconvenience he would suffer by interrupting his occupation even for a day."

Many other ophthalmologists[10] could be cited to indicate that in the more recent years cycloplegics might well be used less and judgment should be exercised in individual cases rather than routine cycloplegia in every refractive case. Some of these authorities will be referred to later, but to bring us to a climax at this point we might consider the statements of William H. Crisp,[11] one of the foremost ophthalmologists in this country, as recorded in his paper "Shall We Use Cycloplegics?":

"Some optometrists condemn cycloplegics, and present to the layman a dark picture of the dangers that accompany the instillation of cycloplegics. That such propaganda is purely selfish in character can hardly be doubted. Moreover, if the law were modified to allow optometrists to use cycloplegics, they would be the first to announce the advantages to be gained to their customers or patients, and would promptly avail themselves of such legal sanction.

"One may readily acknowledge that it is not absolutely necessary to resort to cycloplegia in every refractive examination, even in fairly young persons, although very few ophthalmologists venture to deny the necessity of employing cycloplegics in children of preschool age.

"I have repeatedly asserted that no one can be regarded as an expert refractionist who could not make an approximately accurate measurement of the refractive error without cycloplegia in most of his patients. It is to be regretted that many medical refractionists do not make a careful analysis of the patient's refraction until the ciliary muscle has been paralyzed, and then base their measurements almost entirely upon the retinoscopic findings, supplementing these findings, at best, with a hurried and inadequate check-up of the corrected vision at the trial case."

It is understandable how the practice of using cycloplegics became so widespread among ophthalmologists. The physician who elects to specialize in ophthalmology usually takes a residency in ophthalmology at one of the large eye hospitals where there are large free clinics. The patients who frequent these clinics are usually different from those who can afford to consult men in private practice. The clinic patients are most often young children, illiterate adults, and aged people whose intelligence and cooperation are such that non-cycloplegic methods are very difficult and time consuming. The great numbers of such patients and limited time and facilities of most large eye clinics have made it necessary to adopt the use of cycloplegics because by so doing a refractive examination requires very little time on the part of the interne or the resident and, furthermore, because of the difficulty of subjective tests with the type of patients involved, a quick retinoscopy with the accommodation paralyzed is considered adequate.

Many ophthalmologists who have learned during their internship or residency to refract only with a cycloplegic find it difficult—if they consider the possibility at all—to refract without cycloplegic when they

are in private practice. It is quite natural that the young ophthalmologist is very cautious and hesitant, upon entering private practice, to try on his first few patients a method of refraction with which he is not familiar. Therefore, feeling safer to use the method he has been taught, he puts off any attempt to learn non-cycloplegic methods of refraction.

It is wise, of course, for anyone to use and depend upon the method of refraction that he knows best and with which he obtains good results. It would be quite foolhardy to expect that one who has used cycloplegics during his year or two of clinic experience could suddenly feel confident in private practice without the use of cycloplegics.

The ideal training, and this is admitted by many prominent ophthalmologists, would be for the eye interne and resident to learn both the non-cycloplegic and the cycloplegic method of refraction so that they would have an opportunity to discover the advantages and disadvantages of both methods—enabling them to judge when they get into private practice which method, or both, is indicated in individual cases. There is a definite trend at the large clinics to teach more of the various methods of refraction, but conditions are not as ideal as they should be. This is not so much because of the lack of interest or lack of competent teachers, but, primarily, it is because of socio-economic factors. As mentioned before, the type of patients on which the eye interne or resident has the opportunity to work is not suited for painstaking refraction and, furthermore, the great number of patients (often two to three times more than the staff can handle well) makes it very difficult, if not impossible, to teach more than the minimum of fundamentals.

Despite these difficulties, however, definite progress is being made. When one realizes that it is only within the last fifty years that much attention has been given to the correction of refractive anomalies, it is remarkable that the methods used are as good as they are in view of the demand by the indigent public exceeding the facilities available.

The use of cycloplegics in private practice is much different than it is in the large clinics. Most ophthalmologists in private practice who devote part of their time to teaching and supervising the work in the clinics do not use cycloplegics on their private patients as often as they recommend its use on clinic patients. The reasons for this have been stated. Nevertheless, there is by no means common agreement among most ophthalmologists in private practice on the use of cycloplegics in refraction.

Human nature being what it is, many ophthalmologists never deviate from the rote practices they learned in their internship. Only a

few have the inquisitiveness to study and investigate further once their formal training is finished. The details of establishing a practice, maintaining conventional social and financial standards, as well as the "glamor" of surgery, all overshadow in many cases the acquisition of more knowledge in the field of refraction. It is no wonder, then, that only relatively few ophthalmologists have investigated the methods of non-cycloplegic refraction. However, these few are definitely outstanding men in ophthalmology, and, fortunately, they may influence greatly not only their fellow ophthalmologists, but also the teaching in the medical schools and hospitals.

Of course, the same may be said of many optometrists who continue to be biased toward that which they were taught as students, but who have been too busy to investigate other means of refraction. It is not peculiar to ophthalmologists, nor to optometrists, but it is an almost universal human frailty that *"what one does not understand, he opposes."* It should be self-evident that in order to render an opinion about the use or the non-use of cycloplegics, one should be thoroughly cognizant, not with one method, but with both methods.

III. THE PHARMACOLOGY OF CYCLOPLEGICS:

The alkaloids of belladonna inhibit the function of the structures that are innervated by the postganglionic cholinergic nerves. Careful studies of the action of atropine date from the isolation of this drug as a pure alkaloid by Mein[12] in 1831. Atropa belladonna produces the alkaloids atropine and hyoscyamine, as does Datura stramonium, commonly known as Jamestown or Jimson weed, stink weed, thorn-apple, or devil's apple. The alkaloid scopolamine (hyoscine), which is also a mydriatic and cycloplegic, but which currently is used less often than atropine or homatropine, is found mostly in the shrub Hyoscyamus niger (henbane).

The natural belladonna alkaloids are organic esters formed by a combination of an aromatic acid, tropic acid, and complex organic bases, either tropine or scopine. The synthetic alkaloids usually contain mandelic instead of tropic acid, and a simpler organic base than tropine. Homatropine is a synthetic alkaloid produced by a combination of the base tropine with a somewhat simpler organic acid than tropic acid, namely, mandelic acid.

The cycloplegic and mydriatic drugs are available in several forms —drops, ointments, tablets, etc. The various forms have their individual advantages and disadvantages. The greatest advantage of ointments is that the lacrimal puncta is blocked by the greasy base and the

drug is prevented from running into the nose, throat, and stomach. Also, the ointment form is the easiest to instill, especially by unskilled parents. However, the big disadvantage from the refractive standpoint is the residual greasiness causing uncertain retinoscopy and subjective tests. The ophthalmic tablets or discs have an advantage in not causing a sudden blink on insertion, but they do have a gradual increasing stinging effect resulting often in excessive lacrimation and epiphoria with loss of the drug and uncertain dosage. Also, some tablets contain gelatine which on dissolving tends to produce striations in the retinoscopic reflex. The most widely used form is the liquid. The drops are quickly absorbed and do not interfere with retinoscopy. They do not cause as much stinging as in the case of the tablets but some skill is necessary in administering them. Care should be taken that the drug does not run into the nose and, also, that the patient does not squeeze out the fluid by a quick closing of the lids.

IV. PHYSIOLOGICAL ACTION OF CYCLOPLEGICS

Atropine, homatropine (which may be considered simply as weakened atropine), and scopolamine paralyze the sphincter muscle of the iris and the ciliary muscle of the crystalline lens to cholinergic nerve impulses. The intraocular pressure in *normal* eyes is not disturbed by atropine, although it may be raised by atropine and other mydriatics including cocaine in eyes with glaucoma or those predisposed to glaucoma.

The usual preparation of atropine is one per cent aqueous solution of the sulphate salt. One or two drops of the solution are instilled in the conjunctival sac and pressure is exerted in the region of the inner canthus to prevent the drug from reaching the nasal mucosa, where it might be absorbed in amounts sufficient to cause unfavorable systemic effects. For the purposes of cycloplegia, the instillation is repeated at intervals for several hours until complete, or an adequate, paralysis of the accommodation is attained. Pupillary dilation with atropine in healthy eyes may last as long as ten days, but the cycloplegic effect wears off in four to five days.

Homatropine is usually used in five per cent solution of its hydrobromate or hydrochloride salt. It is of shorter mydriatic duration than atropine (1 to 2 days) and its cycloplegic effect disappears even sooner than the mydriasis. It is often used in combination with ephedrine, paredrine, or benzedrine which hasten the mydriatic effect, but have little, if any, cycloplegic effect.

The main danger in the ophthalmological use of atropine is the possibility of increasing an already elevated intraocular pressure. Glaucoma is possible with the improper use of atropine and blindness may result. The pressure should always be tested before using atropine or any mydriatic agent.

A brief review* of the physiological basis of cycloplegia is pertinent. The drugs which are used to produce cycloplegia can be roughly divided into two classes, namely:

A. Those drugs which not only dilate the pupil but also paralyze the ciliary muscle, such at atropine and its allies, these drugs being known as cycloplegics. and

B. Those drugs which cause dilation of the pupil primarily with but little or no effect upon the ciliary muscle. These drugs are known as mydriatics. and in this class we find adrenalin and its allies. and cocaine and its allies.

The action of the above mentioned drugs upon the pupil of the eye is most interesting and complex. Recent advances made in studying the control of the pupil have pointed to a mechanism known as humoral control. This is a physio-chemical mechanism by which the nervous system maintains direct control over the action of the pupil.

The internal muscles of the eye concerned with pupillary reaction are the dilator and sphincter muscles of the pupil. The autonomic nervous system is the regulator of these muscles. This system is concerned chiefly with the action of smooth or involuntary muscles of the body. The autonomic nervous system can further be divided into two groups. the sympathetic system, and the parasympathetic system. Drugs which cause an effect similar to stimulation of the sympathetic system are known as sympathomimetic drugs. and those drugs which cause actions similar to stimulation of the parasympathetic system are known as parasympathomimetic drugs. The innervation of the dilator muscle of the pupil is under the control of the sympathetic nervous system, and the innervation of the constrictor muscle of the iris is actuated by the parasympathetic system.

The ciliary muscle, which is the third internal ocular muscle, is not concerned directly with dilation or contraction of the pupil, but is mainly concerned with the accommodation range of the eye. It is by the action of this muscle in relaxing the tension of the zonule upon the periphery of the lens that we are enabled to see both near and far. The innervation of the ciliary muscle is complex. However, at present it is thought that two mechanisms are employed in the innervation of the ciliary muscle during accommodation. There is not only a stimulator

*James Miles O'Brien. M.D.. of the Dartmouth Eye Institute. kindly collaborated on this section.

effect acting through the sympathetic system, but also an inhibition probably actuated by the third nerve. It is thought by some authorities that the action of atropine in paralyzing accommodation is caused mainly by inhibiting the effect of the third nerve in a manner similar to its action upon the vagus nerve. The exact mechanism of the innervation and suppression or depression of the ciliary muscle is not quite clear at this time. It seems to be a twofold mechanism concerned with stimulation via the sympathetics, and inhibition through the third nerve by means of the above mentioned humoral control.

In 1905, Elliott (Journal of Physiology, 32, 1905) pointed out the need for a new concept of the motivation of the autonomic nervous system. It is well known that atropine when instilled in the eye dilates the pupil and paralyzes the ciliary muscle. The effects of atropine are purely peripheral as may be demonstrated by dropping it on half of the cornea and noting that only half of the pupil dilates. However, it was further shown that when one applied atropine directly to the ciliary muscle it produced no paralysis, nor did it paralyze the nerves stimulating the ciliary muscle when applied directly to these same nerves. Therefore, it was thought that the atropine, acting neither upon the ciliary muscle itself, nor upon the nerves supplying this muscle, must have acted upon the junction of the nerve with the muscle fiber. This myo-neural junction, as it has been termed, is therefore the area in which the drugs used in cycloplegia carry out their effect. The further work of Dale (British Medical Journal 1835, 1934), and Loewi (R.g.—Physiologie CCIV, CCVI, 1920-24) have shown that the sympathetic nervous system acts to cause pupillary dilation by releasing an adrenalin-like substance at this myo-neural junction, and that the parasympathetic system acts to cause contraction of the pupil by releasing acetylcholine at the myo-neural junction. Thus, the humoral control of the internal muscles of the eye depends upon the presence of certain substances at the myo-neural junction, and the presence or absence of these specific chemical substances is the actual basis of the resulting dilation or contraction of the pupil.

Those drugs which by their action imitate the sympathetic nervous system are known as sympathomimetic. Such drugs as benzedrine, paredrine, and adrenalin fall in this category. Their action in dilating the pupil is not caused by depression of the sphincter muscle, as is the case with atropine and its allies, but by direct stimulation of the sympathetic system. Therefore, when homatropine is used in conjunction with paredrine to produce cycloplegia, the dilation of the pupil is caused

by two mechanisms; one stimulating the dilator fibers, the other paralyzing the contraction fibers of the iris. This renders the time required to produce effective cycloplegia much less than that when homatropine or atropine is used alone, and its advantages are therefore evident. The accompanying diagram (Figure 1)* illustrates the innervational components of the iris and ciliary body.

V. TYPES OF CYCLOPLEGICS

In most large clinics, as well as in many private practices, the standard cycloplegic for children under ten years of age is one per cent atropine sulfate. One drop is instilled three times a day for three days. Between the ages of ten and twenty, two per cent homatropine is often used, one drop every ten minutes until a total of six drops have been instilled. Two drops of five per cent homatropine and one drop of one per cent paredrine, at three minute intervals, is used frequently in patients between ages 20 and 46. This type of cycloplegic produces rapid mydriasis and loss of accommodation in 45 to 60 minutes. Normal pupil size and accommodation are recovered in about 25 hours whereas, when atropine is used, normal function may be impaired for seven to ten days.

There has been considerable work done in the search for a cycloplegic that produces pupillary dilation and paresis of the accommodation in a short time and whose effects wear off quickly. Myersen and Thau[13] were the first to suggest the use of benzedrine in combination with atropine. In 1937, Beach and McAdams[14] made a study on the subject and advocated benzedrine sulfate in a one per cent solution in combination with a one per cent solution of atropine or a five per cent solution of homatropine. They concluded that the cycloplegia reached its height in 50-70 minutes, and that the effect of benzedrine combinations with the regular cycloplegics gave greater cycloplegic effect than did the atropine or homatropine alone.

Powell and Hyde[15] reached the same conclusions. They reported that with the combination cycloplegic recovery was reached in eight hours as opposed to eighteen hours required for the simple atropine or homatropine. Tassman[16] advocates the use of paredrine, which is closely related to benzedrine, in combination with homatropine. He claims that greater cycloplegia in a shorter time with quicker recovery is obtained with the combination of paredrine and homatropine than is possible with homatropine alone.

However, Prangen,[17] Thorne and Murphy,[18] Weneas, Evans, and Odom[19] differ with the above conclusions. Their studies lead them to conclude that the number of instillations has little effect on the efficiency

*See page 568.

of the cycloplegic, but two drops of two per cent homatropine seems preferable to one drop of five per cent homatropine since when only one drop is administered the patient may squeeze it out of the conjunctival sac. Furthermore, they found that the addition of paredrine did not seem to hasten the cycloplegia nor the recovery from it.

Weneas, Evans and Odom[19] agree with Prangen[17] that patients should be individualized, the amount and kind of cycloplegia varying with the individual case. They urge accurate measurements of the residual accommodation as the best criterion of the completeness of the cycloplegia rather than reliance upon any formula of drugs. Prangen[17] concluded that a residual accommodation of two to three diopters after the cycloplegic had been given allowed accurate refraction, regardless of age, and that further reduction seemed unnecessary.

Recently, two new drugs have been synthesized and are reputedly ideal as cycloplegics. Hydrochloride of benzyloildiethylamino-ethamol (cycloplegina) has been produced by Freire and Rocha[20] (1944) in a Brazilian laboratory and it is reported that it causes cycloplegia in twenty minutes which lasts only eight hours. In this country, Swan and White[21] reported (1944 and 1945) on their new mydriatic and cycloplegic drug, dibutoline sulfate, and claim for it rapid action as a cycloplegic and a short period of visual disability with negligible systemic effects from ocular administration. Unlike the atropine series, this new drug has equal effect on the iris and ciliary body, and, consequently, the size and reaction of the pupil provide a convenient indication of the degree of cycloplegia.

VI. VARIOUS OPINIONS AND DATA ON THE CLINICAL USE OF CYCLOPLEGICS

In a subject as important and widespread as that of refraction, it is understandable that there are various opinions as to the best techniques. It is almost axiomatic that those who have the least knowledge make the most extravagant claims; whereas, those who are the most experienced recognize the merits, as well as the pitfalls, of various methods of refraction.

Harrison T. Butler,[22] prominent English ophthalmologist, in a paper read before the Ophthalmological Society of the United Kingdom in 1922 concluded:

". . . that refraction without a cycloplegic is as accurate as that with one if only correct methods are employed, and if sufficient experience and skill are at the hands of the refractionist."

Butler also stated that he thought the beginner would be wise to use a cycloplegic frequently because of insufficient experience.

Lancaster, in discussing Butler's paper, concurred in the recommendation of using a cycloplegic for refractive purposes as little as possible.

Another English ophthalmologist, J. Burdon-Cooper[23], speaking before the Ophthalmological Society of the United Kingdom in 1925 described an interesting phenomenon of finding less hyperopia under atropine than when the eyes were tested binocularly without atropine. He stated that this phenomenon did not occur with cocaine or homatropine, and he concluded:

". . . that the most reasonable explanation that can be given is that the phenomenon is due to some forward displacement of the lens system as a whole, producing what is in reality a relative myopia."

In the discussion which followed, among those who spoke against the use of atropine indiscriminately and of their favorable experience in bilateral fogging without cycloplegic were: H. Traquair of Scotland, A. E. Davis of New York City, W. A. Crisp of Denver, and Harrison T. Butler of London.

Duke-Elder[24] writes of some of the disadvantages of cycloplegics in refraction as follows:

"The eye with its accommodation paralysed is a pathological eye, and cannot be legitimately compared with the normal organ. The dilation of the pupil alters considerably the optical properties of its refractive apparatus, and intensifies the physical errors due to aberration through the peripheral parts of the refractive media. Further, the periphery of the pupillary aperture frequently has a refraction quite different from the central part, which is alone employed in the normal circumstances of life."

Nevertheless, it would not be correct to say that Duke-Elder disapproves entirely of the use of cycloplegics. He points out that it does have its usefulness in young people with active accommodation.

One can find in the literature many references by English ophthalmologists who found that cycloplegics are unnecessary for accurate refraction except, possibly, in the very young. That fewer American ophthalmologists are able to refract without cycloplegics can only be due to their training and subsequent experience, as well as the feeling by some American ophthalmologists that the use of cycloplegics distinguishes them from the optometrists. In England, the refracting optician is not prohibited by law from using cycloplegics and the use of cycloplegics in England is not a mark of distinction as it is in this country.

Those American ophthalmologists who insist that the use of cycloplegics is essential for accurate refraction do not indicate that they have tried to refract without cycloplegics and have compared the results of both types of refraction. On the other hand, those ophthalmologists who maintain that they have found the use of cycloplegics

relatively unnecessary do indicate that they have used both the cycloplegic and the non-cycloplegic methods.

No doubt, the greatest advocate of non-cycloplegic refraction among the American ophthalmologists is Walter B. Lancaster. Over thirty years ago, Lancaster,[25] who is now considered the dean of American ophthalmologists, wrote:

"Moreover, many (ophthalmologists) are finding that they can measure with precision the astigmatism as to axis and amount by skillful use of the astigmatic charts *without cycloplegia.*" (The italics are Lancaster's).

He continued:

"Since this is precisely my own experience I speak with great boldness, knowing that my statements have the backing of men of the best training and soundest judgment. I urge all beginners and all who are not so fixed in their ruts that it is hopeless to expect them to change, to give this matter careful investigation."

In concluding a discussion of his technique of non-cycloplegic refraction using the fogging method and the astigmatic chart, Lancaster[25] wrote:

"Let us measure our patients with as great precision as possible and spare no pains; but let us be honest with ourselves and not suppose we are more accurate than we really are or that whoever differs from us is wrong, or that by using a cycloplegic all error will be eliminated."

Furthermore, Lancaster[26] in the 1943 Graduate Lectures of the American Academy of Ophthalmology and Otolaryngology (Practical Physiological Optics) stated:

"Of great importance are the changes in refraction both spherical and cylindrical which are caused by dilating the pupil, changes which are due not to the action or lack of action of the ciliary muscle (accommodation) but to the complications arising from an enlarged pupil which permits rays passing through the peripheral parts of the cornea and lens to share in the image formation and even dominate the image formation. Since the area of pupil added by mydriasis is greater than the original area of an average pupil (the area of an 8 mm. pupil is four times as large as a 4 mm. pupil, i.e., the area added to the 4 mm. pupil by dilating it is three times the area of the original pupil.) Hence the characteristics of the added area may far outweigh the characteristics of the original pupillary area. The irrefragable conclusion is that only a test made with a pupil of normal working size not dilated by 'drops' nor by working in a dimly lighted room (a lighted chart on a black wall for example) can give accurate measurements of refractive errors."

Cyclodamia

As a result of his experiences on draftee examinations during World War I, Dorland Smith[27] developed a technique of non-cycloplegic refraction which he termed "cyclodamia." Although his papers do not give any specific statistics, he stated that he had examined several thousand cases and that the

". . . total refractive error could often be estimated more dependently by skiascopy checked by blurred vision than by sharp vision alone."

Furthermore, evidence confirming this observation was afforded by a study of the difference between the amount of error revealed by a refractive method known as "Combined Skiascopy and Fogging" and that revealed by a subsequent cycloplegic.

Smith's method, first described in 1926, is essentially one of overfogging. Following his retinoscoptic tests with binocular distant fixation, in which he corrected both the spherical and cylindrical components of the ametropia, he proceeded to the subjective tests without removing the "working distance" correction. The patient's vision was, therefore, blurred (or fogged) by approximately + 1.50 D. sph. O.U. giving about 20/200 visual acuity. The spherical lenses were then modified binocularly and gradually until maximum vision was obtained. Smith considered it very important during his retinoscopy and subjective tests to avoid giving the patient even a brief period of sharp vision until the very end of his tests. He contended that his method resulted in "maximum accommodative relaxation" and that the ametropia revealed by this method checked closely with that found under cycloplegia.

Smith summarized his paper as follows:

"Knowledge of the accommodative habit and behavior of every patient is essential to the determination of the proper correction of his refractive error. This knowledge is only obtained by the fogging and manifest examinations. While the total error may always be measured under cycloplegia, and in some cases only under cycloplegia, it may often be sufficiently closely approximated by the cyclodamic method described in this paper: quite dependably so when good relaxation is obtained and all its tests agree; less dependably so in other cases. This method obtains an amount of accommodative control which is usually greater and always more reliable than that of fogging, and often but slightly less than that of cycloplegia, by making every smallest detail of the examination contribute to the production of maximum accommodative relaxation. The refractive error thereby revealed often has to be measured without the use of sharp vision, which has been shown to prevent maximum relaxation in many young people. Once the novel principles and methods of cyclodamia are well understood, it is easier and quicker than cycloplegia, and may well replace it in young people as well as old, if recourse is had to cycloplegia whenever relaxation is poor or accommodative behavior is irregular. Since it differs from all other noncycloplegic methods in that it is the total error which it reveals or approximates when good relaxation is obtained, it should always be followed by a fogging and manifest examination, and the correction determined as a variation from the total error, just as after a cycloplegic."

Dorland Smith anticipated some objections from his fellow ophthalmologists regarding his intimation that refractions could often be done as accurately without, as with, cycloplegics. He stated that one of the objections to his claim of non-cycloplegic accuracy would be:

"Any discussion of non-cycloplegic refraction should be avoided because it may give aid and encouragement to the optometrist, who may perhaps distort it for purposes of propaganda."

However, Smith had an answer prepared which may well be considered by both optometrists and ophthalmologists:

". . . we have long since learned that it is usually far better to obtain, discuss and spread scientific knowledge than to try to restrict it: . . . distorted science ultimately reacts against the distorter."

Data (Kurtz')

At the 1932 meeting of the American Academy of Optometry,

Kurtz[28] reported on his study of the use of cycloplegics in refraction. His patients consisted of 65 healthy, World War I service men, 18 years of age and over. The cycloplegic used was a mixture of two per cent homatropine and two per cent cocaine; two drops were instilled every ten minutes for one hour or more until complete cycloplegia was obtained.

Kurtz concluded that:

"There is more disagreement between the retinoscopic and subjective findings under a cycloplegic refraction than is found in the same kind used in a manifest refraction."

This conclusion that there was "more disagreement" between the retinoscopic and subjective findings with cycloplegia is not significant on inspecting the data. Combining Kurtz' tables 7, 8, 9, 10, 17, 18, 19, and 20, the following comparison is evident (see Table A).

TABLE A—KURTZ' DATA

Retinoscopy and Subjective Tests	With Cyclo		Non-Cyclo	
	Eyes	Per cent	Eyes	Per cent
Findings agree	49	41.5	51	45
Findings differ	69	58.5	62	55
Total	118	100.0	113	100

It is obvious that there is less than five per cent difference between the respective data in the cycloplegic and in the non-cycloplegic columns above. Rather than being indicative of "disagreement," this is remarkable *agreement* since a five per cent difference could be due easily to error in repeatability.

Another interesting comparison of Kurtz' data may be made from his Tables 4, 5, 6, 14, 15, and 16 which give the spherical and cylindrical subjective findings without and with cycloplegic. From this comparison it is evident that Kurtz found just about as many cases with more astigmatism as with less astigmatism under cycloplegia. However, with respect to the spherical ametropia Kurtz found a significant number (46%) showing more hyperopia under cycloplegia. (see Table B).

TABLE B—KURTZ' DATA

Subjective Findings	Sphere		Cylinder	
	Eyes	Per cent	Eyes	Per cent
No difference with cyclo	39	46	38	64
Greater error found with cyclo				
to extent of + 0.25 D.	17	20	5	8
to extent of + 0.50 D.	8	9	3	5
to extent of + 0.75 D. to + 1.00 D.	7	8	2	3
to extent of + 1.25 D. to + 2.00 D.	2	2	0	0
to extent of + 2.25 D. to + 4.00 D.	6	7	0	0
Less error found with cyclo				
to extent of + 0.25 D.	7	8	9	15
to extent of + 0.50 D	0	0	1	2
to extent of + 0.75 D. to + 1.00 D.	0	0	2	3
Total	86	100	60	100

Data (Tait and Sinn)

Tait and Sinn[29] studied the use of homatropine from the standpoint of ciliary muscle tonus. They maintained (page 78):

> "In the use of cycloplegics for refraction purposes, therefore, the important factor is not the extent to which the accommodative amplitude is inhibited but the way and extent to which the normal ciliary tonus or a ciliary hypertonus is affected."

The subjects used by Tait and Sinn were 150 college students, between the ages of *18 and 23*, who were previously corrected for ametropia and who had no marked accommodation or convergence anomalies nor *any history of asthenopia*. It should be pointed out that their subjects cannot be considered as representative of those seen in routine clinical practice. The type of cycloplegic used consisted of "gelatin ophthalmic discs containing 1/50 gr. each of two per cent homatropine hydro-bromide and cocaine hydrochloride."

Tait and Sinn concluded (page 83):

1. "At the present time there is a widespread lack of understanding among all groups of refractionists of the physiological basis of ciliary muscle tonus variations.
2. "The important factor in refraction procedure as far as accommodation is concerned is the variability of tonic, or postural activity of the ciliary muscle. The amplitude of accommodation has no necessary relationship to level of ciliary tonus.
3. "With homatropine, *used in the way and in the amounts indicated above*, there is no definitely predictable ciliary response as far as can be determined with the limited number of subjects used.
4. "As there is no constant or predictable effect on normal ciliary tonus it is probable that there is similarly no predictable effect in ciliary hypertonus.
5. "Data obtained with homatropine cycloplegia is usable in refraction analyses only if the limits of possible clinical error are recognized. The limits of usual variability, as determined by the limited number of subjects used in this experiment, are from 1.50 D. of relaxation to 0.75 D. of stimulation."

The important criticism of Tait's and Sinn's report is that adequate cycloplegia in many of their subjects was not obtained by the type of cycloplegic used. In 86, or 57 per cent, of their cases a residual accommodation of two diopters or less was found after the administration of the cycloplegic. These cases may be considered as clinically acceptable for cycloplegic refraction. However, in 64, or 43 per cent, of their cases a residual accommodation greater than two diopters was found after administration of the drug. These cases cannot be considered as being under cycloplegia and results obtained from such cases should be interpreted as possibly arising from incomplete cycloplegia. Nevertheless, there is significant agreement in Tait and Sinn's data, (see their Graph I and that to be presented later in this report [Graph XVII]). Tait and Sinn should be given credit for having established a fairly satisfactory basis for predicting the variation in the effect of cyclo-

plegia upon the zero level of accommodation in a group of individuals of the type used.

Data (Betts and Austin) (Hunt and Betts)

Betts and Austin[30] in investigating visual problems of school children reported on a comparison of the refractive findings with and without a cycloplegic. Their subjects consisted of 126 fifth-grade school children between the ages of 10 and 14.5 years. Homatropine and paredrine were used. They concluded (page 74):

"There was no substantial difference between the cylindrical findings revealed by means of the cycloplegic and those discovered by means of the subjective method.

"It was found that the subjects could accept approximately 0.50 D. more plus under cycloplegia than they could in the subjective finding."

The same data as used in Betts' and Austin's study were reported in a condensed form by Hunt and Betts[31] in the American Journal of Ophthalmology. Relative to the cycloplegic findings, they summarized as follows (page 1094):

15. "*Cycloplegic findings.* In general, there was a fairly high relationship between the manifest and cycloplegic findings. No subject accepted minus sphere on the subjective and plus sphere on the cycloplegic."

Data (Seigneur)

Seigneur[32] reported on his experience with the use of cycloplegics in the Army during World War II. His cases were between the *ages of 18 and 39*. Homatropine, five per cent, was used and the cycloplegic examination preceded the non-cycloplegic refraction. Seigneur came to the following conclusions:

1. "That this cycloplegic method is unreliable in detecting the least amount of minus lens to be prescribed.
2. "That this method in hyperopes gives indefinite information as to the amount of plus that the patients will accept in the final prescription.
3. "That this cycloplegic method is an inaccurate way of determining cylindrical axis.
4. "That before a cycloplegic method can be of value as a method of refraction it must produce a constant predictable effect upon the accommodative mechanism."

It is difficult to justify these conclusions from the data which Seigneur presented. He highlighted his findings that 39.8 per cent of the myopic patients showed "more minus on the cycloplegic than on the manifest," but he minimized the finding of only 2.5 per cent of the hyperopes showing less plus with the cycloplegic and also that 61.6 per cent of the hyperopes showed more plus under cycloplegia. This latter group far outweighs the others and might well be the significant feature of his study. Nevertheless, Seigneur did not present a graph showing how much more hyperopia was found under cycloplegia in the 61.6 per cent of these cases, but he did emphasize with graphs the degree of greater myopia found with cycloplegia in the 39.8 per cent of

the myopic patients. Seigneur's conclusions relative to the position of the cylindrical axis is contrary to the findings of other studies referred to in this paper. Furthermore, that a cycloplegic should "produce a constant predictable effect upon the accommodative mechanism" is not an impossibility. Thorough cycloplegia does produce a predictable effect upon the accommodative mechanism in that it reduces the accommodation to a minimum.

VII. DATA FROM THE CLINICAL DIVISION OF THE DARTMOUTH EYE INSTITUTE

(a) Selection of Cases:

The data presented in this study were obtained from the records of the Clinical Division of the Dartmouth Eye Institute. It is important to realize that the patients who were given thorough non-cycloplegic and cycloplegic refractions were routine cases. These patients had symptoms and other characteristics which seemed to warrant the cycloplegic refraction in addition to the non-cycloplegic refraction. In other words, the cases used were bonafide patients with symptoms. It is understandable that if a more selected group were used the findings might differ from those found in this study. For instance, if the group studied consisted of young men between the ages of 18 and 22 with no particular symptoms and with no significant ametropia, the findings might be more uniform, but such a study would have little bearing on what is found in the usual clinical practice.

The non-cycloplegic examination preceded the cycloplegic refraction. This procedure not only furnished information which helped in the decision that a cycloplegic should be used, but it also made it possible for the non-cycloplegic examiner to do his work without foreknowledge of the cycloplegic findings. If the cycloplegic refraction had preceded the refraction determined by the fogging technique, it might be claimed that the knowledge of the supposedly total error found under cycloplegia influenced the non-cycloplegic findings.

The professional personnel responsible for the data presented in this study consisted of four optometrists, four ophthalmologists, and two nurses who administered the cycloplegic drops under the opthalmologists' supervision. In general, the optometrists did both the non-cycloplegic and the cycloplegic refractions using the same technique in both instances.

(b) Procedure:

After a careful recording of the patient's age, occupation, history,

and symptoms the following ocular examinations were made:

1. *Visual Acuity, with and without previous correction*
2. *External and Ophthalmoscopic Examinations*
3. *Keratometer Measurements*
4. *Retinoscopy*
   a. Working Distance 66 cm. (1.50 D.)
   b. Binocular Fixation—20 ft. target
   c. Maximum plus (or minimum minus) spherical correction sought
   d. Minus cylinder used
   e. Consistent attention given toward keeping eyes slightly fogged—i.e., interval of Sturm pre-retinal
   f. Dynamic retinoscopy findings estimated when necessary
   g. Finally, there was left before patients' eyes the lenses, determined by retinoscopy, which overcorrected the hyperopia, or undercorrected the myopia slightly—i.e., to the extent of ¼ to ½ D., the residual shadow being slightly against in all meridians.
5. *Subjective Refraction*
   a. The 1.50 D. allowance for the working distance of 66 cm. and also the cylinders were removed leaving the spherical correction only before the patient's eyes.
   b. One eye was occluded and a rough estimate made of the visual acuity of the non-occluded eye. Depending upon the astigmatism (which was not yet corrected), the vision would be fairly good (20/25 or 20/20) if there was little or no astigmatism, or it would be poor (20/40 to 20/100) depending upon the amount of astigmatism. To judge the completeness of the fog, first + 0.50 sphere then − 0.50 D. sphere was held before the eye being tested. If the + 0.50 sphere made the patient see worse definitely and − 0.50 sphere gave better vision, the conclusion was that the hyperopia was fully corrected or the myopia minimally corrected. If the patient reported just as good vision with the additional + 0.50 sphere as without it, the conclusion was that the "fog" was inadequate and the + 0.50 sphere was added to the lens already in place. This procedure was continued until the above phenomena of an additional + 0.50 D. sphere made the vision worse definitely. However, the experienced retinoscopist rarely found it necessary to alter the spherical component determined by his retinoscopic examination.
   c. Once the proper fog had been established, the next step was the use of the Lancaster-Regan astigmatic chart and dial.[33] The patient's attention was directed first to the chart with spokes, or radiating lines, every 10° for a complete circle. The patient was asked simply which lines, or group of lines, appeared clearer. In case the patient replied that no lines appeared clearer than others, a difference was made by flipping the 0.12 D. cross cylinder in the four cardinal positions (minus x 90, x 180, x 45, and x 135), and if the corresponding lines appeared clearer, it was concluded that the astigmatism was less than ¼ D. However, in most cases, some lines appeared darker than others and the examiner determined the *center* of the clearer group by holding a large pointer on a line which had an equal number of clear lines to either side. The rotating dial was then set to correspond to the center of the clearer lines and minus cylinders were inserted with axis perpendicular to the darker line of the rotating dial until both lines were equally clear.
   d. Visual acuity was determined, monocularly and binocularly. The best vision with the greatest plus sphere, or the least minus, was recorded as the final subjective finding. Various check tests such as the use of an additional + 0.50 D. sphere O.U. and the cross cylinders on letters were also employed.
   e. Near point tests consisted of the dynamic cross cylinder tests, monocularly and binocularly, the amplitude of accommodation (push-up method), and visual acuity determinations.

6. Motility Examination

a. Phoria-distance and near
b. Fusional amplitudes-distance and near
c. Near point of convergence

7. Stereopsis

The factors which influenced the decision to use a cycloplegia were:

1. Age of patient.
2. Poor cooperation on the objective and subjective tests.
3. Significant differences between the keratometer, retinoscopic and the subjective findings.
4. Anomalous motility findings.
5. Differences between patient's old correction and the new findings which were insufficient to account for the symptoms reported.

In children and especially in strabismic cases, the type of cycloplegic used was atropine (one per cent), one drop in each eye three times a day for three days. In other cases, homatropine (five per cent) with paredrine (one per cent) was used; one drop of each was instilled at three minute intervals—first a drop of the homatropine then three minutes later one drop of paredrine, and finally in another three minutes a second drop of homatropine was given. The refraction was begun one hour after the last drop had been instilled.

The completeness of the cycloplegia was judged not only by the dilation of the pupils and their lack of response to light, but also by the residual accommodation present. Occasionally, cases were found in which the residual accommodation exceeded two, three, and even four diopters. This could be due to improper administration of the drug. Some patients, especially children, squeeze their lids together despite admonitions to the contrary as soon as the drops are instilled in which case some of the drug may run down their cheeks rather than remain in their eyes. Furthermore, there are variations in individual tolerances to cycloplegic drugs. Because of these two reasons much more of the drug is used than is necessary. Nevertheless, as mentioned heretofore, there were few cases encountered during the time this project was conducted which did not respond adequately. The data from these cases were not used since it cannot be stated with certainty that the eyes were refracted under cycloplegia. The cases included in this report as being under cycloplegia are those whose residual accommodation, with cycloplegic, was not over 2 D.

The same refractive technique used in the pre-cycloplegic examination was employed when the eyes were examined under cycloplegia.* The time spent for each examination was approximately the same, about 20 to 30 minutes. The personnel who did the refractions, both without and with cycloplegic, were similarly trained and of about equal

*Some have assumed that near-point tests, (phorias, fusional amplitudes, dynamic

experience. There was no incentive to influence the findings toward greater agreement or disagreement. There was a consistent interest to record exactly what was found in order to determine, primarily, what was best for the patient, and, secondly, what a summary of a large number of cases would indicate relative to the comparative findings.

It should be acknowledged that while the data presented herein were obtained in as scientific a manner as possible under routine clinical conditions, nevertheless, the results should not be expected to compare as favorably as those found in the studies previously mentioned where the cases were more selected especially with regard to age and relatively insignificant symptoms. On the other hand, the data collected in this study should not be compared to that found in the large hospital refracting clinics since it is realized that in the latter institutions the manifest and the cycloplegic examinations are so unlike in technique, in purpose, and in time that variations found might well be due to the differences in technique rather than to the fact that a cycloplegic was used in one instance and not in the other. The data presented in this paper should resemble more closely that found in a private practice where there is sufficient time and interest to do a thorough "fogging technique" non-cycloplegic refraction, as well as a refraction under cycloplegia.

Therefore, this analysis of refractive findings without and with a cycloplegic may serve to indicate the value of both methods and thereby guide those interested in a more scientific treatment of their patient's ametropia and their symptoms. The completeness as well as the limitations of this data should be appreciated by those who study this report. There is no reference in the literature which covers the subject as thoroughly nor in which the data reported were obtained by refractionists as experienced with one method as with the other and in which the circumstances of the non-cycloplegic and the cycloplegic refraction were so similar to those found in a private practice. However, there is one important consideration which one should have in mind when studying this data, namely, the repeatability of refractive findings. The more experienced refractionist will realize that he cannot duplicate within ± 0.25 D., and sometimes ± 0.50 D., the findings on a given case. Differences of this amount may well be considered normal or due to errors inherent in the instability of the condition being measured and the vacillation of the examiner's judgment.

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cross cylinder tests, etc.) cannot be made under cycloplegia. These tests can be made and were made in this study. Of course there is a difference in the findings without and with a cycloplegic. It is this difference which indicates the completeness of the cycloplegia and the role that accommodation plays in the binocular findings.

TABLE 1

SUMMARY OF DIFFERENCES FOUND UNDER CYCLOPLEGIA
(ATROPINE and HOMATROPINE—1.000 eyes)

HYPEROPIC CASES

(594 eyes)

AGES	More Hy. Eyes	More Hy. Per Cent	No Change Eyes	No Change Per Cent	Less Hy. Eyes	Less Hy. Per Cent	Total Eyes	Total Per Cent
0-10 yrs.	111	85	17	13	2	2	130	100
10-20 yrs.	145	68	46	21	24	11	215	100
20-30 yrs.	84	61	39	29	14	10	137	100
30-40 yrs.	57	73	16	21	5	6	78	100
40-50 yrs.	13	38	11	33	10	29	34	100
	410	69	129	22	55	9	594	100

MYOPIC CASES
(406 eyes)

AGES	Less My. Eyes	Less My. Per Cent	No Change Eyes	No Change Per Cent	More My. Eyes	More My. Per Cent	Total Eyes	Total Per Cent
0-10 yrs.	24	54	15	34	5	12	44	100
10-20 yrs.	106	41	84	33	65	26	255	100
20-30 yrs.	16	20	36	46	27	34	79	100
30-40 yrs.	5	33	4	27	6	40	15	100
40-50 yrs.	1	8	7	54	5	38	13	100
	152	38	146	36	108	26	406	100

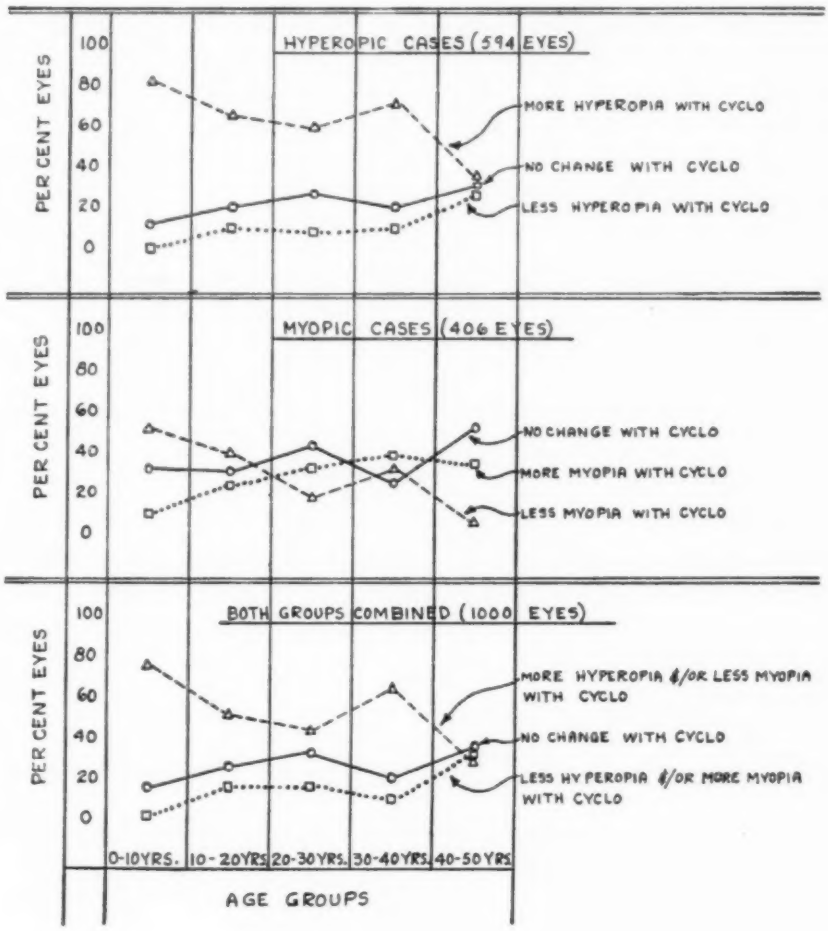
BOTH GROUPS COMBINED
(1000 eyes)

AGES	More Hy. Less My. Eyes	More Hy. Less My. Per Cent	No Change Eyes	No Change Per Cent	Less Hy. More My. Eyes	Less Hy. More My. Per Cent	Total Eyes	Total Per Cent
0-10 yrs.	135	78	32	18	7	4	174	100
10-20 yrs.	251	53	130	28	89	19	470	100
20-30 yrs.	100	46	75	35	41	19	216	100
30-40 yrs.	62	67	20	21	11	12	93	100
40-50 yrs.	14	30	18	38	15	32	47	100
	562	56	275	28	163	16	1000	100

GRAPH I

DIFFERENCES FOUND UNDER CYCLOPLEGIA

(COMBINED ATROPINE AND HOMATROPINE CASES-1000EYES)



(c) Results

Table I and Graph I present a composite picture of the spherical subjective findings without and with cycloplegia. The headings "More Hy.," "Less Hy.," "Less My.," and "More My.," mean more hyperopia, less hyperopia, less myopia, and more myopia, respectively, found under cycloplegia as compared to that found without cycloplegia. The lower limit considered as a refraction change was 0.25 D. This

TABLE II

SUMMARY OF DIFFERENCES FOUND UNDER CYCLOPLEGIA
(HOMATROPINE—728 EYES)

HYPEROPIC CASES
(409 eyes)

AGES	More Hy. Eyes	More Hy. Per Cent	No Change Eyes	No Change Per Cent	Less Hy. Eyes	Less Hy. Per Cent	Total Eyes	Total Per Cent
0-10 yrs.	24	86	3	11	1	3	28	100
10-20 yrs.	82	62	32	24	18	14	132	100
20-30 yrs.	84	61	39	29	14	10	137	100
30-40 yrs.	57	73	16	21	5	6	78	100
40-50 yrs.	13	38	11	33	10	29	34	100
	260	64	101	25	48	11	409	100

MYOPIC CASES
(319 eyes)

AGES	Less My. Eyes	Less My. Per Cent	No Change Eyes	No Change Per Cent	More My. Eyes	More My. Per Cent	Total Eyes	Total Per cent
0-10 yrs.	3	20	11	73	1	7	15	100
10-20 yrs.	73	37	71	36	53	27	197	100
20-30 yrs.	16	20	36	46	27	34	79	100
30-40 yrs.	5	33	4	27	6	40	15	100
40-50 yrs.	1	8	7	54	5	38	13	100
	98	31	129	40	92	29	319	100

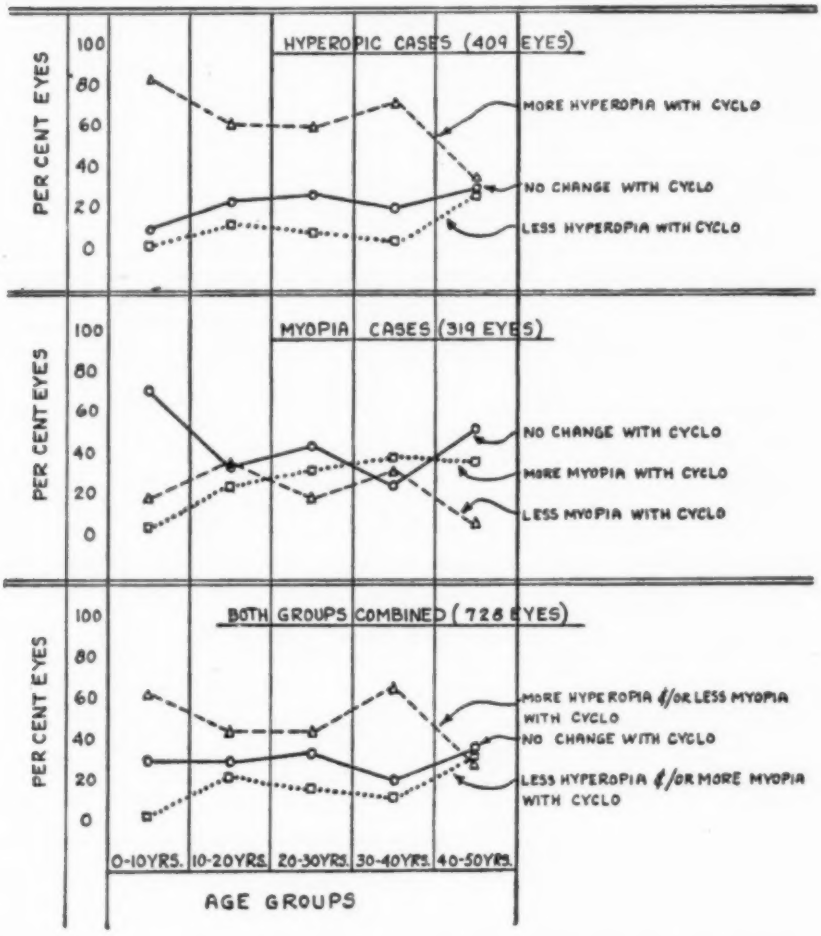
BOTH GROUPS COMBINED
(728 eyes)

AGES	More Hy. Less My. Eyes	More Hy. Less My. Per Cent	No Change Eyes	No Change Per Cent	Less Hy. More My. Eyes	Less Hy. More My. Per Cent	Total Eyes	Total Per Cent
0-10 yrs.	27	63	14	32	2	5	43	100
10-20 yrs.	155	47	103	31	71	22	329	100
20-30 yrs.	100	46	75	35	41	19	216	100
30-40 yrs.	62	67	20	21	11	12	93	100
40-50 yrs.	14	30	18	38	15	32	47	100
	358	49	230	32	140	19	728	100

GRAPH II

DIFFERENCES FOUND UNDER CYCLOPLEGIA

(HOMATROPINE -728 EYES)



is true not only in Table I and Graph I, but also in all the following tables and graphs unless otherwise specified. By "No Change" is meant that the same findings, within ± 0.25 D., were obtained in both the cycloplegic and the non-cycloplegic tests.

Inspection of Table I and Graph I indicates several interesting points which are obvious in less time than it takes to relate them. First of all, it is clear that in the younger age groups a definitely greater per-

TABLE III

SUMMARY OF DIFFERENCES FOUND UNDER CYCLOPLEGIA
(ATROPINE—272 EYES)

HYPEROPIC CASES
(185 eyes)

AGES	More Hy. Eyes	More Hy. Per Cent	No Change Eyes	No Change Per Cent	Less Hy. Eyes	Less Hy. Per Cent	Total Eyes	Total Per Cent
0- 5 yrs.	19	86	3	14	0	0	22	100
5-10 yrs.	68	85	11	14	1	1	80	100
10-15 yrs.	63	76	14	17	6	7	83	100
	150	81	28	15	7	4	185	100

MYOPIC CASES
(87 eyes)

AGES	Less My. Eyes	Less My. Per Cent	No Change Eyes	No Change Per Cent	More My. Eyes	More My. Per Cent	Total Eyes	Total Per Cent
0- 5 yrs.	2	100	0	0	0	0	2	100
5-10 yrs.	19	70	4	15	4	15	27	100
10-15 yrs.	33	57	13	22	12	21	58	100
	54	62	17	20	16	18	87	100

BOTH GROUPS COMBINED
(272 eyes)

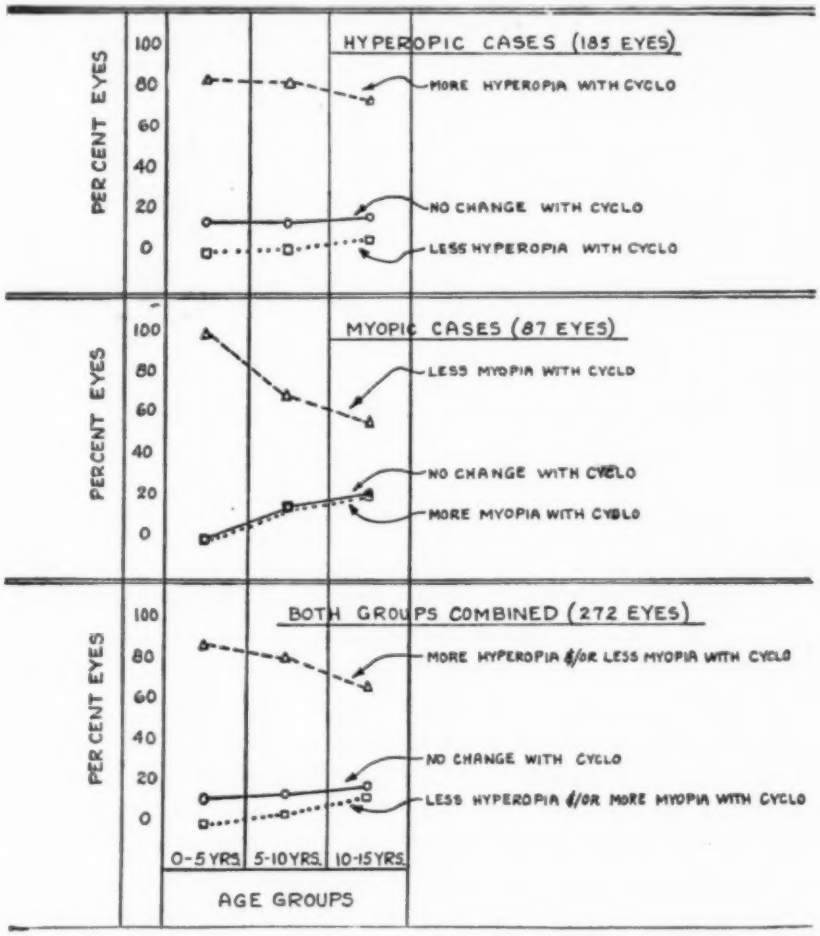
AGES	More Hy. Less My. Eyes	More Hy. Less My. Per Cent	No Change Eyes	No Change Per Cent	Less Hy. More My. Eyes	Less Hy. More My. Per Cent	Total Eyes	Total Per Cent
0- 5 yrs.	21	88	3	12	0	0	24	100
5-10 yrs.	87	81	15	14	5	5	107	100
10-15 yrs.	96	68	27	19	18	13	141	100
	204	75	45	17	23	8	272	100

centage of the cases showed more hyperopia or less myopia under cycloplegia. It is interesting to note that as the age of the patients increased, there was gradually less tendency to find more hyperopia, or less myopia, with cycloplegia. Secondly, the percentage of cases in which the cycloplegic and the non-cycloplegic findings were the same ("No Change") is lowest in the younger people and highest in the older age groups. Thirdly, there were a certain percentage of eyes that showed,

GRAPH III

DIFFERENCES FOUND UNDER CYCLOPLEGIA

(ATROPINE - 272 EYES)



contrary to what is expected theoretically, less hyperopia, or more myopia, under cycloplegia. This is definitely more marked in the myopic eyes and also as the age of the patients increased.

It should be borne in mind that the 0.25 D. limit constituting a "change" is a very low limit. There were a great many cases that showed only a 0.25 D. change and although these are included, it should be realized that a 0.25 D. change could well be due to errors in measurement as well as to the addition of the cycloplegic.

Tables II and III with their accompanying Graphs II and III

TABLE IV

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(Atropine-Hyperopia 185 eyes)

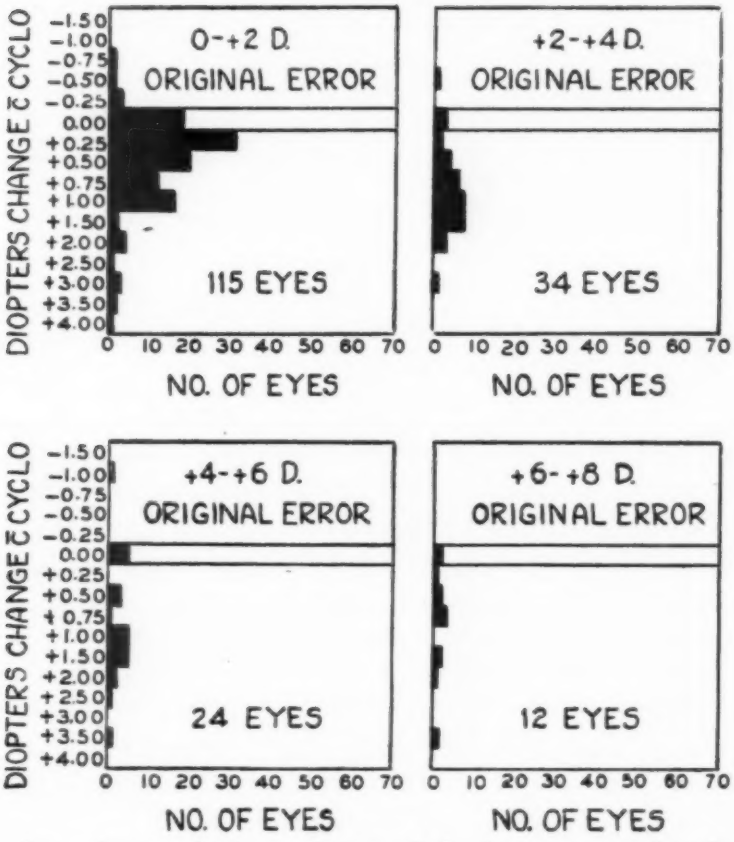
Amount of Change c Cyclo.	0-2D Original Error Eyes	0-2D Per Cent	2-4D Original Error Eyes	2-4D Per Cent	4-6D Original Error Eyes	4-6D Per Cent	6-8D Original Error Eyes	6-8D Per Cent	Total Eyes	Total Per Cent
− 1.00 D.	0	0	0	0	1	4	0	0	1	½
− 0.75 D.	1	1	0	0	0	0	0	0	1	½
− 0.50 D.	1	1	1	3	0	0	0	0	2	1
− 0.25 D.	3	3	0	0	0	0	0	0	3	1½
0.00 D.	18	15	3	8	5	21	2	17	28	15
+ 0.25 D.	31	27	2	6	0	0	1	8	34	19
+ 0.50 D.	20	17	4	12	3	13	2	17	29	16
+ 0.75 D.	12	10	6	18	1	4	3	25	22	12
+ 1.00 D.	16	14	7	21	5	21	0	0	28	15
+ 1.50 D.	2	2	7	21	5	21	2	17	16	9
+ 2.00 D.	4	3	3	8	2	8	1	8	10	5
+ 2.50 D.	1	1	0	0	1	4	0	0	2	1
+ 3.00 D.	3	3	1	3	0	0	0	0	4	2
+ 3.50 D.	2	2	0	0	1	4	1	8	4	2
+ 4.00 D.	1	1	0	0	0	0	0	0	1	½
	115	100	34	100	24	100	12	100	185	100

show a breakdown of the data on 1,000 eyes in the four groups of hyperopic and myopic cases in which atropine was used and also the hyperopic and myopic eyes in which homatropine (with paredrine) was used as the cycloplegic. These two tables and graphs show that a change indicative of ciliary relaxation under cycloplegia is found more frequently in the hyperopic than in the myopic case. Furthermore, the age factor is apparent in that a greater percentage of the younger patients showed changes under cycloplegia. Comparing the data obtained using homatropine and atropine indicate that, in general, more cases were found to have more hyperopia or less myopia with atropine. This may be due not only to the greater cycloplegic effect of atropine, but also to the fact that the patients were younger and the control of their accommodation on the non-cycloplegic tests more difficult than in the case of older patients. Another consideration is that the younger patients more often than the older patients had not worn any previous corrections, and, therefore, their accommodation was more active not only because of their youth but also because they had had the necessity of attempting to compensate for their ametropia.

GRAPH IV

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(ATROPINE-HYPEROPIA-185 EYES)



In order to obtain a picture of the importance of such factors as the amount of original* error and age of patient on the influence of cycloplegics, Tables IV to XI with their respective Graphs IV to XI were prepared. It is not necessary to discuss these as the various points of significance are self-evident on inspection. It might have been better in the graphs to have used percentages rather than the actual number of eyes showing various differences, but in all cases the total number

*Since the non-cycloplegic examination was done first, these findings were considered the "original error."

TABLE V

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(Atropine-Myopia 87 eyes)

Amount of Change c Cyclo.	0-2D Original Eyes	0-2D Error Per Cent	2-4D Original Eyes	2-4D Error Per Cent	4-6D Original Eyes	4-6D Error Per Cent	6-8D Original Eyes	6-8D Error Per Cent	Total Eyes	Total Per Cent
− 2.00 D.	0	0	0	0	0	0	1	10	1	1
− 0.75 D.	1	2	0	0	0	0	0	0	1	1
− 0.50 D.	2	4	3	12	0	0	0	0	5	6
− 0.25 D.	4	8	1	4	3	100	1	10	9	10
0.00 D.	11	23	4	16	0	0	2	20	17	20
+ 0.25 D.	17	35	5	20	0	0	0	0	22	26
+ 0.50 D.	7	14	8	32	0	0	0	0	15	17
+ 0.75 D.	5	10	4	16	0	0	0	0	9	10
+ 1.00 D.	2	4	0	0	0	0	2	20	4	5
+ 1.50 D.	0	0	0	0	0	0	1	10	1	1
+ 2.00 D.	0	0	0	0	0	0	2	20	2	2
+ 4.00 D.	0	0	0	0	0	0	1	10	1	1
Total	49	100	25	100	3	100	10	100	87	100

of eyes are given for each group. The accompanying tables do present the per cent figures. In comparing each graph alone, the actual numerical value is often better appreciated.

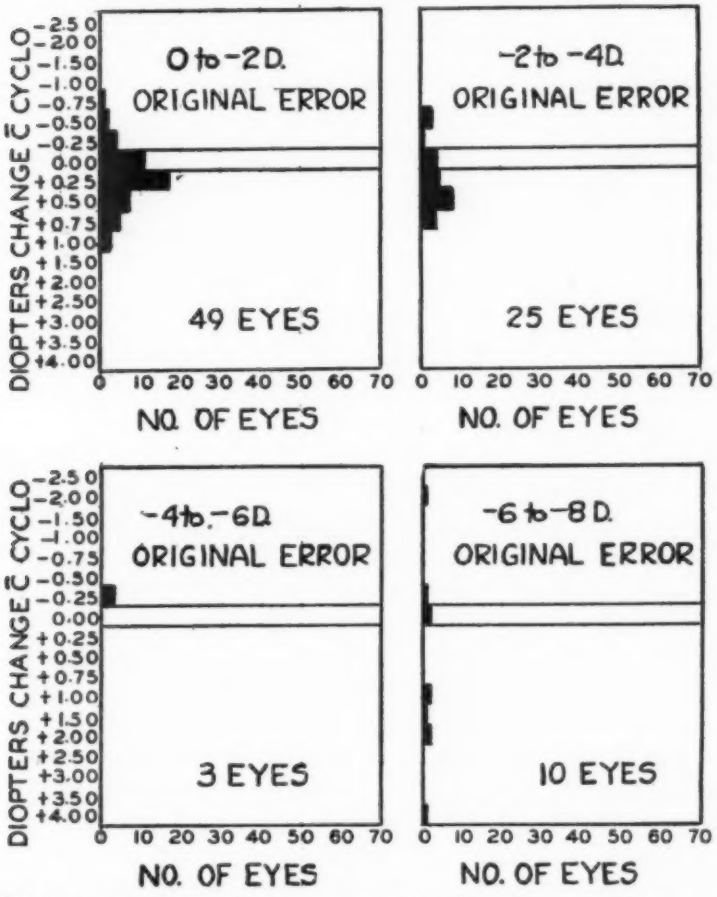
Tables XII and XIII with Graphs XII and XIII summarize the differences found under cycloplegia according to amount of original error and according to age groups when ± 0.50 D. difference is taken as the lower limit of clinical significance. It is obvious that the greatest differences under cycloplegia are found in the hyperopic cases and especially in the younger patients where atropine was used.

Table XIV and Graph XIV present the differences in the subjective astigmatic findings without and with cycloplegia. These data indicate that significant differences in amount or in axis were *not* found in the vast majority of cases. In only 15 per cent of the cases were differences greater than ± 0.25 D. found under cycloplegia and less than 10 per cent of the cases showed a difference greater than ten degrees in axis with cycloplegia. In view of Tscherning's[34] figures on the refractive differences in various areas of a large dilated pupil, many writers favoring the non-cycloplegic method of refraction have used this point as an argument against cycloplegics. The data presented herein give the findings as they are usually obtained under cycloplegia without the use of

GRAPH V

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(ATROPINE - MYOPIA - 87 EYES)



an artificial pupil. Several cases were tested using a 3.5 mm. artificial pupil, but no significant differences (± 0.25 D.) were found. These facts support both the cycloplegic as well as the non-cycloplegic method of refraction and the refractionist may, therefore, feel confident if he uses one method or the other. The choice of method will rest with the individual practitioner. However, the inconvenience and time factor to the patient being greater with the cycloplegic method constitutes a decided disadvantage for this method.

The Scattergraphs XV and XVI may interest those who prefer

TABLE VI

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(Homatropine—Hyperopia 409 eyes)

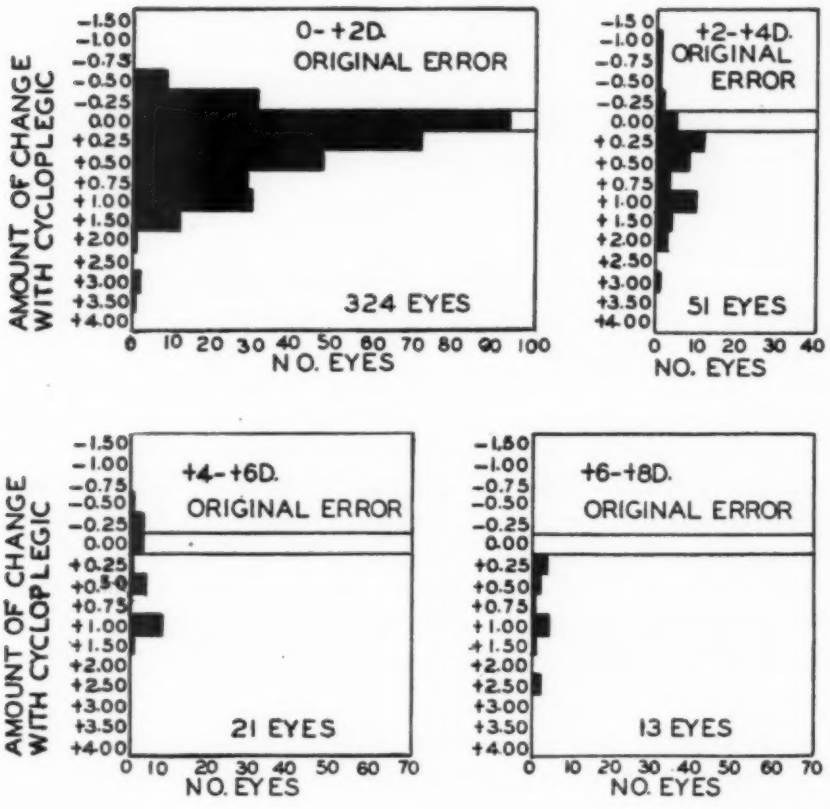
Amount of Change c Cyclo.	0-2D Original Error Eyes	0-2D Per Cent	2-4D Eyes	2-4D Per Cent	4-6D Eyes	4-6D Per Cent	6-8D Eyes	6-8D Per Cent	Total Eyes	Total Per Cent
− 1.00 D.	0	0	1	2	0	0	0	0	1	0
− 0.75 D.	0	0	1	2	0	0	0	0	1	0
− 0.50 D.	8	2	1	2	1	5	0	0	10	2
− 0.25 D.	31	9	2	4	3	14	0	0	36	9
0.00 D.	93	29	5	10	3	14	0	0	101	25
+ 0.25 D.	72	22	12	23	1	5	3	23	88	22
+ 0.50 D.	47	14	8	16	4	19	2	15	61	15
+ 0.75 D.	28	8	3	6	0	0	1	8	32	8
+ 1.00 D.	29	9	10	19	8	38	4	31	51	12
+ 1.50 D.	12	4	4	8	1	5	1	8	18	4
+ 2.00 D.	1	1	3	6	0	0	0	0	4	1
+ 2.50 D.	0	0	0	0	0	0	2	15	2	1
+ 3.00 D.	2	1	1	2	0	0	0	0	3	1
+ 3.50 D.	1	1	0	0	0	0	0	0	1	0
Total	324	100	51	100	21	100	13	100	409	100

this type of graph. Along the abscissa (horizontal axis) is plotted the spherical amount of the original error, that is, the non-cycloplegic ametropia. The ordinate scale (vertical axis) represents the *change* in diopters found under cycloplegia. It will be noted that the bulk of the data fall quite closely along the horizontal axis indicating for the vast majority of cases less than one diopter change under cycloplegia. There is a definite indication for the change under cycloplegia to be one of more hyperopia or less myopia. Furthermore, it is evident that the greater changes are to be found in the hyperopic cases.

Graph XVII represents a summary of the differences found under cycloplegia in the combined 1,000 eyes studied. Allowing ± 0.25 D. as the lowest limit of repeatability of refractive findings and another ± 0.25 D. as the limit of clinical significance, making a total allowance of ± 0.50 D., it is evident that *74.4 per cent of the eyes examined in this study can be considered to have shown no clinically significant difference under cycloplegia.* On the other hand 25.6 per cent of the cases did show a significant difference with cycloplegics. It is important to note that the major differences found were those of more hyperopia and/or less myopia under cycloplegia.

GRAPH VI

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR (HOMATROPINE-HYPEROPIA-409 EYES)



An analysis of those cases in which greater than 0.50 D. difference was found under cycloplegia is an important matter. This will be taken up in detail in a further paper, but, in general, these cases presented rather marked evidence on the non-cycloplegic tests from which an experienced refractionist could suspect latent hyperopia or a ciliary hypertonicity.

Finally, Graph XVIII shows a summary of the prescriptions given. In general, the prescriptions were decided upon by conferences

TABLE VII

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(Homatropine-Myopia 319 eyes)

Amount of Change c Cyclo.	0-2D Original Error		2-4D Original Error		4-6D Original Error		6-8D. Original Error		Total	
	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent
− 2.00 D.	0	0	1	2	0	0	0	0	1	0
− 1.50 D.	1	1	0	0	1	4	0	0	2	1
− 1.00 D.	1	1	0	0	0	0	0	0	1	0
− 0.75 D.	2	1	1	2	0	0	0	0	3	1
− 0.50 D.	10	4	7	14	2	7	0	0	19	6
− 0.25 D.	53	22	10	19	3	11	0	0	66	20
0.00 D.	98	41	16	31	14	52	1	100	129	40
+ 0.25 D.	40	16	9	18	0	0	0	0	49	15
+ 0.50 D.	17	7	2	4	2	7	0	0	21	7
+ 0.75 D.	4	1	1	2	4	15	0	0	9	3
+ 1.00 D.	9	3	2	4	0	0	0	0	11	4
+ 1.50 D.	2	1	0	0	0	0	0	0	2	1
+ 2.00 D.	1	1	0	0	1	4	0	0	2	1
+ 3.00 D.	2	1	2	4	0	0	0	0	4	1
Total	240	100	51	100	27	100	1	100	319	100

between the ophthalmologist and optometrist. Both the non-cycloplegic and the cycloplegic findings were considered. The patient's age, occupation, previous corrections and other pertinent factors naturally influenced the decisions in prescribing. No arbitrary deductions from the cycloplegic findings were made routinely. The same type of judgments which all refractionists must make in prescribing were followed.

VIII. SUMMARY

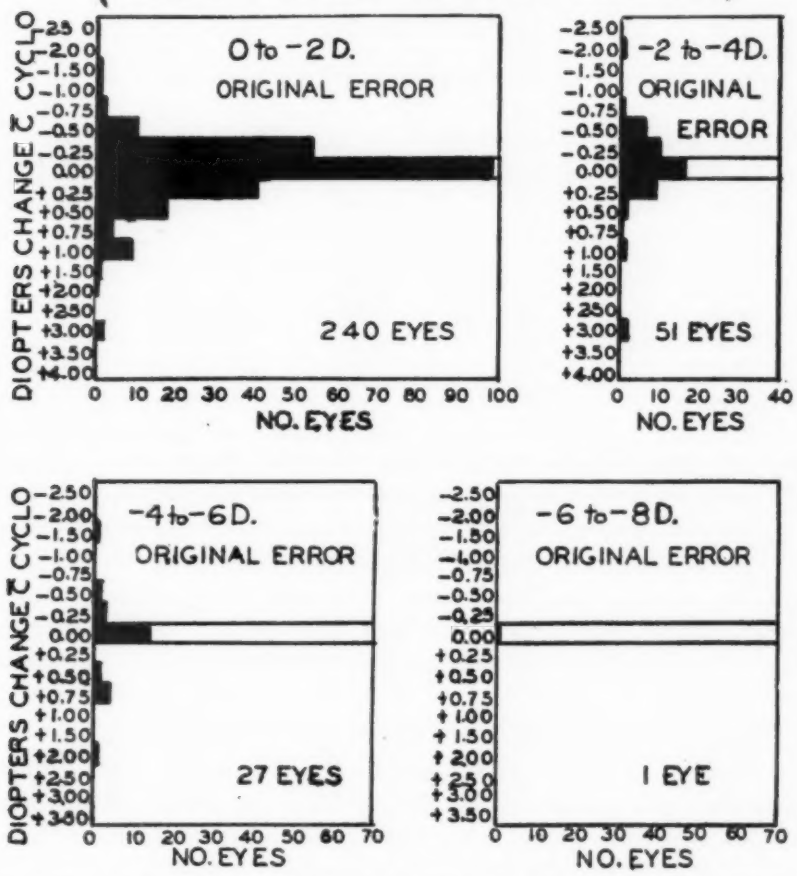
As set forth in the introduction of this paper, there was no intention of trying to prove the value of non-cycloplegic refraction to the belittlement of the use of cycloplegics or, vice versa, that the use of cycloplegics was the best method of measuring ametropia. The fortunate rapport between the ophthalmologists and the optometrists who cooperated in this study was such as to make both groups mutually interested in investigating carefully the two methods, cycloplegic and the fogging technique, so that: (1) patients could be treated best, and (2) so that a basis for further opinions relative to refractive procedures could be established.

In any study it is worthwhile usually to examine the background

GRAPH VII

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

(HOMATROPINE-MYOPIA-319 EYES)



of established practices. It is hoped that the brief historical notes presented in this paper will assist in clarifying what has been to many the beclouded origin of the use of cycloplegics. Wells' perspicacity in 1809 which led to the discovery of the cycloplegic effect of mydriatics occurred soon after Thomas Young's great work (in 1801) which disclosed the seat of accommodation. During this era when scientific interest concerning accommodation was considerable and the means of de-

TABLE VIII
COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUP
(Atropine-Hyperopia 185 eyes)

Amount of Change c Cyclo.	0-5 yrs.		5-10 yrs.		10-15 yrs.		Total	
	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent
− 1.00 D.	0	0	1	1	0	0	1	1
− 0.75 D.	0	0	0	0	1	1	1	1
− 0.50 D.	0	0	0	0	2	2	2	1
− 0.25 D.	0	0	0	0	3	4	3	1
0.00 D.	3	14	11	14	14	17	28	15
+ 0.25 D.	5	23	9	11	20	24	34	18
+ 0.50 D.	4	18	13	16	12	15	29	16
+ 0.75 D.	2	9	9	11	11	13	22	12
+ 1.00 D.	0	0	14	18	14	17	28	15
+ 1.50 D.	2	9	11	14	3	4	16	9
+ 2.00 D.	4	18	6	7	0	0	10	5
+ 2.50 D.	0	0	2	3	0	0	2	1
+ 3.00 D.	2	9	0	0	2	2	4	2
+ 3.50 D.	0	0	3	4	1	1	4	2
+ 4.00 D.	0	0	1	1	0	0	1	1
Total	22	100	80	100	83	100	185	100

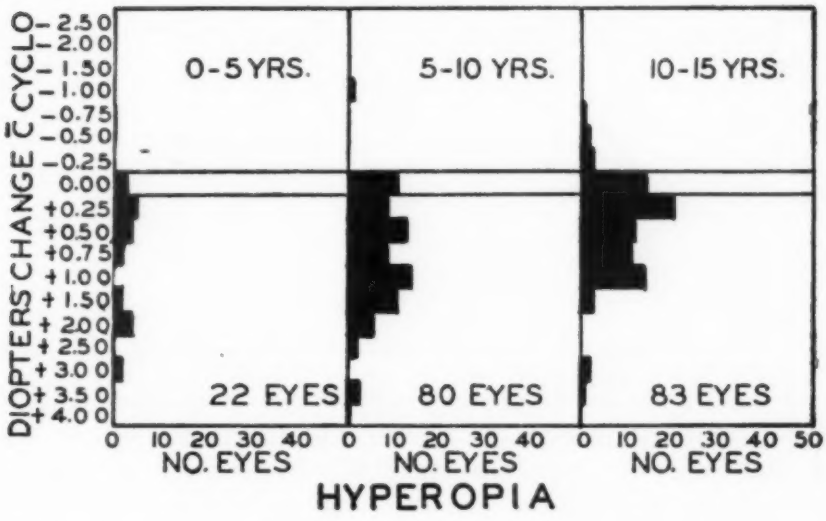
termining the refractive status of the eye were limited, it is understandable that a method which paralyzed the accommodation was accepted as a great and important tool. At that time, the devices used to determine ametropia were various forms of optometers which afforded repeatable reading for the trained observers who could control their accommodation, but which were not very helpful in determining the refractive condition of the average person suffering from ametropia and asthenopia.

Donders' great influence and especially his insistence on a relationship of hyperopia, accommodation, asthenopia, and convergent strabismus (still known as "Donders' Type of Squint") has been carried down by one leader after another in ophthalmology. Naturally, Donders advised the use of cycloplegics since it had just been recently discovered that accommodation was governed by the ciliary body, rather than by the extrinsic muscles as previously believed, and since it had been demonstrated that accommodation was inhibited by atropine. No better method was available for determining the static refraction of the eye. Note that Donders' definition of refraction, given in the beginning of this paper, stated the condition of freedom from accommodation.

In recent years, there has been a definite trend in ophthalmology, as well as in optometry, to consider the refraction from a more func-

GRAPH VIII

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUP (ATROPINE)



tional point of view. To be sure, refractionists want to determine the ametropia without interference from a spasm or hypertonicity of accommodation, but many do not believe it pertinent to the normal conditions of everyday eye use to determine a prescription based upon tests made when the eyes are in the temporarily pathological status of iris and ciliary paralysis.

If one adheres to Donders' definition of refraction, he must use a cycloplegic to determine the nature and degree of ametropia. Nevertheless, even those who do follow Donders' advice invariably prescribe not their cycloplegic findings, but rather their manifest or post-cycloplegic findings.

Another major factor in the persistent use of cycloplegics in this country has been the relatively minor attention given to training of ophthalmological internes in refraction. Hospital eye clinics in this country are such that only the quickest estimation of refraction has been possible.

TABLE IX

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUP

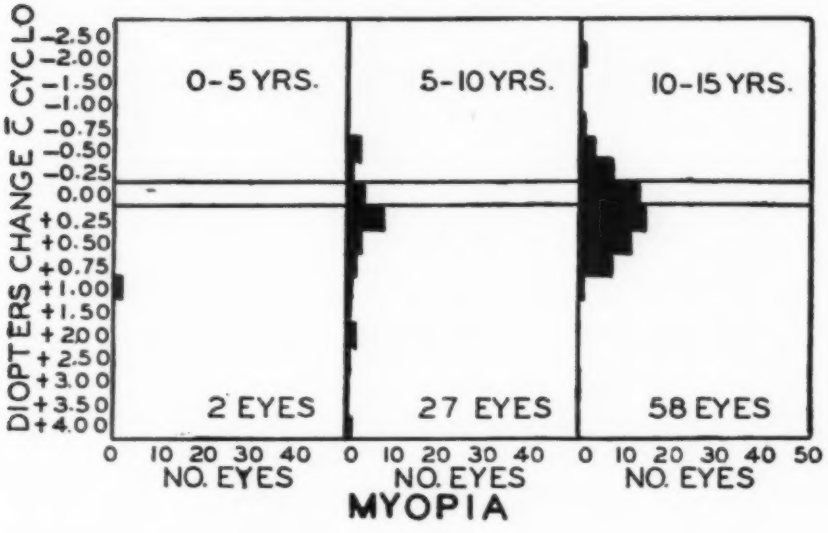
(Atropine-Myopia 87 eyes)

Amount of Change c Cyclo.	0-5 yrs.		5-10 yrs.		10-15 yrs.		Total	
	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent
− 2.00 D.	0	0	0	0	1	2	1	1
− 0.75 D.	0	0	0	0	1	2	1	1
− 0.50 D.	0	0	3	11	3	5	6	7
− 0.25 D.	0	0	2	7	7	12	9	10
0.00 D.	0	0	4	15	13	22	17	20
+ 0.25 D.	0	0	8	30	14	24	22	26
+ 0.50 D.	0	0	3	11	11	19	14	16
+ 0.75 D.	0	0	2	7	7	12	9	10
+ 1.00 D.	2	100	1	4	1	2	4	5
+ 1.50 D.	0	0	1	4	0	0	1	1
+ 2.00 D.	0	0	2	7	0	0	2	2
+ 4.00 D.	0	0	1	4	0	0	1	1
Total	2	100	27	100	58	100	87	100

Recent developments, however, indicate that the more progressive ophthalmological teaching institutions and the increasing number of postgraduate courses in ophthalmology are giving much more attention to physiological optics and to non-cycloplegic determination of ametropia. The less frequent use of cycloplegics for refraction in Europe, particularly in England,[35] is due not only to differences in the education of ophthalmologists but also to the fact that the use of cycloplegics does not distinguish the medical from the non-medical refractionists. In England, the non-medical refractionists are not prohibited by law from using cycloplegics, and while some of them do use cycloplegics routinely, most do not find it necessary. There is no doubt that some medical refractionists in this country find it necessary to rely on their use of cycloplegics for the rather questionable distinction which they believe differentiates them from the optometrists. On the other hand, there are those few leaders in ophthalmology who use discriminately both the fogging technique of non-cycloplegic refraction and the cycloplegic method as and when their patients' needs indicate. The opinions and data of some who have used both methods of refraction are presented in this report.

GRAPH IX

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUP (ATROPINE)



IX. CONCLUSION

The ametropic findings without and with cycloplegic as determined in 1,000 eyes at the Dartmouth Eye Institute are presented. It will bear repeating here that these cases presented do not represent a carefully selected group of subjects of a limited age range who were free of ocular symptoms. Neither do the figures reported represent a run-of-the-mill group of patients. Cycloplegics were not used routinely on *every* patient seen at the Dartmouth Eye Institute. The cases used in this study are those in which it was indicated that the use of cycloplegics might throw some additional light on the patient's visual problem or the condition of his eyes. In many of these cases the cycloplegic was given simply to verify the indications in the pre-cycloplegic examination that accommodation was not relaxed. Therefore, it is understandable that there was found, as should be expected, a fair number who showed significant differences under cycloplegia. If cycloplegics had been used routinely on every refractive case, it is felt that a much lower percentage

TABLE X

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUPS

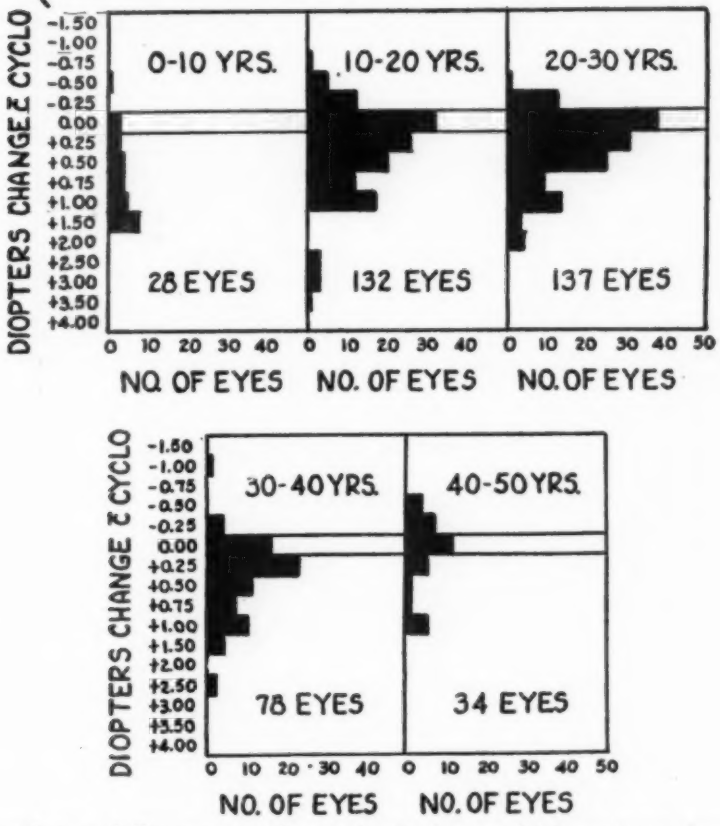
(Homatropine-Hyperopia—409 eyes)

Amount of Change c Cyclo.	0-10 yrs.		10-20 yrs.		20-30 yrs.		30-40 yrs.		40-50 yrs.		Total	
	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent
− 1.00 D.	0	0	0	0	0	0	1	1	0	0	1	0
− 0.75 D.	0	0	1	1	0	0	0	0	0	0	1	0
− 0.50 D.	1	4	5	4	1	1	0	0	4	12	11	3
− 0.25 D.	0	0	12	9	13	9	4	5	7	20	36	9
0.00 D.	3	11	32	24	38	28	16	21	11	32	100	25
+ 0.25 D.	3	11	26	20	31	23	23	30	5	15	88	21
+ 0.50 D.	4	14	20	15	25	18	11	14	1	3	61	15
+ 0.75 D.	4	14	12	9	9	7	7	9	1	3	33	8
+ 1.00 D.	5	18	17	13	13	9	10	13	5	15	50	12
+ 1.50 D.	8	28	0	0	3	2	4	5	0	0	15	4
+ 2.00 D.	0	0	0	0	4	3	0	0	0	0	4	1
+ 3.00 D.	0	0	3	2	0	0	0	0	0	0	3	1
+ 3.00 D.	0	0	3	2	0	0	0	0	0	0	3	1
+ 3.50 D.	0	0	1	1	0	0	0	0	0	0	1	0
Total	28	100	132	100	137	100	78	100	34	100	409	100

GRAPH X

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUP

(HOMATROPINE - HYPEROPIA - 409 EYES)



of significant differences under cycloplegia would have been found. This study indicates the following:

1. In 74.4 per cent of the cases the spherical findings obtained by the two methods agree within clinical limits of ± 0.50 diopters.

2. In 84.5 per cent of the cases the astigmatism found by the two methods agrees within clinical limits of ± 0.25 diopters.

3. In 81.8 per cent of the cases the axis of the astigmatism found by the two methods agrees within clinical limits of ± 5°.

4. In those cases where the difference between the two spherical

TABLE XI

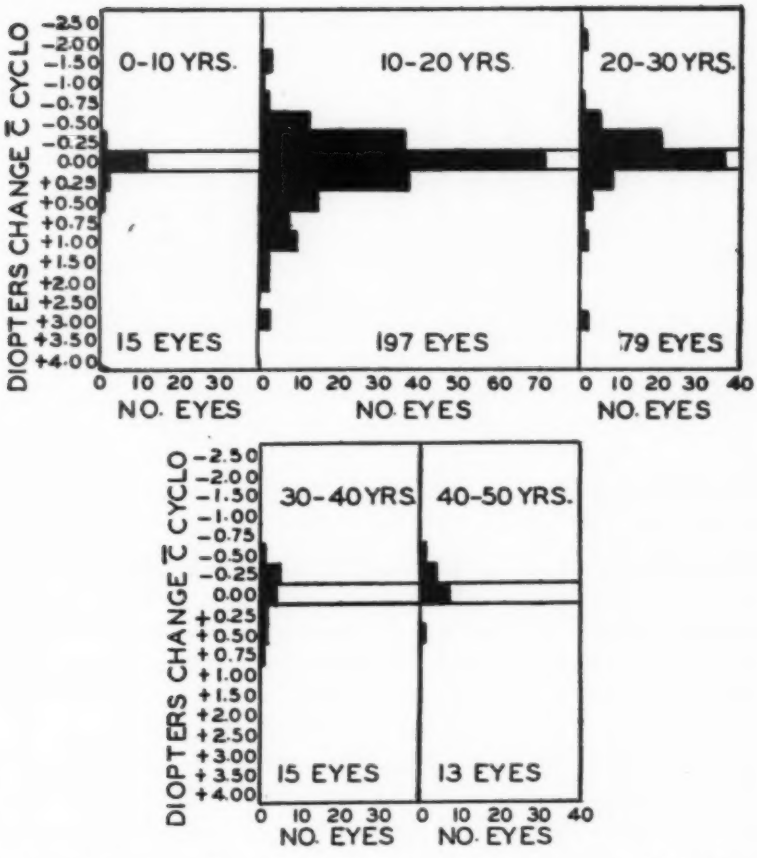
COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUPS

(Homatropine-Myopia—319 eyes)

Amount of Change c Cyclo.	0-10 yrs.		10-20 yrs.		20-30 yrs.		30-40 yrs.		40-50 yrs.		Total	
	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent	Eyes	Per Cent
− 2.00 D.	0	0	0	0	1	1	0	0	0	0	1	0
− 1.50 D.	0	0	2	1	0	0	0	0	0	0	2	1
− 1.00 D.	0	0	1	1	0	0	0	0	0	0	1	0
− 0.75 D.	0	0	2	1	1	1	0	0	0	0	3	1
− 0.50 D.	0	0	12	6	5	6	1	7	1	8	19	6
− 0.25 D.	1	7	36	18	20	25	5	34	4	30	66	20
0.00 D.	11	73	71	36	36	46	4	26	7	54	129	40
+ 0.25 D.	2	13	37	19	8	10	2	13	0	0	49	15
+ 0.50 D.	1	7	14	7	3	4	2	13	1	8	21	7
+ 0.75 D.	0	0	7	3	1	1	1	7	0	0	9	3
+ 1.00 D.	0	0	9	5	2	3	0	0	0	0	11	4
+ 1.50 D.	0	0	2	1	0	0	0	0	0	0	2	1
+ 2.00 D.	0	0	2	1	0	0	0	0	0	0	2	1
+ 3.00 D.	0	0	2	1	2	3	0	0	0	0	4	1
Total	15	100	197	100	79	100	15	100	13	100	319	100

GRAPH XI

COMPARISON OF DIFFERENCES FOUND UNDER CYCLOPLEGIA ACCORDING TO AGE GROUP (HOMATROPINE-MYOPIA-319 EYES)



findings was greater than 0.50 diopters, 16.6 per cent of the total cases showed 0.75 or 1.00 diopters more hyperopia or less myopia under cycloplegia, 7.7 per cent of the total cases showed over 1.00 diopters more hyperopia or less myopia under cycloplegia, and 1.3 per cent of the total cases showed less hyperopia or more myopia under cycloplegia.

5. In the younger age groups the percentage of cases in which more hyperopia was found under cycloplegia was definitely higher than in the older age groups.

TABLE XII

SUMMARY OF CASES WITH MORE THAN ± ½ D. DIFFERENCE UNDER CYCLOPLEGIA ACCORDING TO DEGREE OF ORIGINAL ERROR

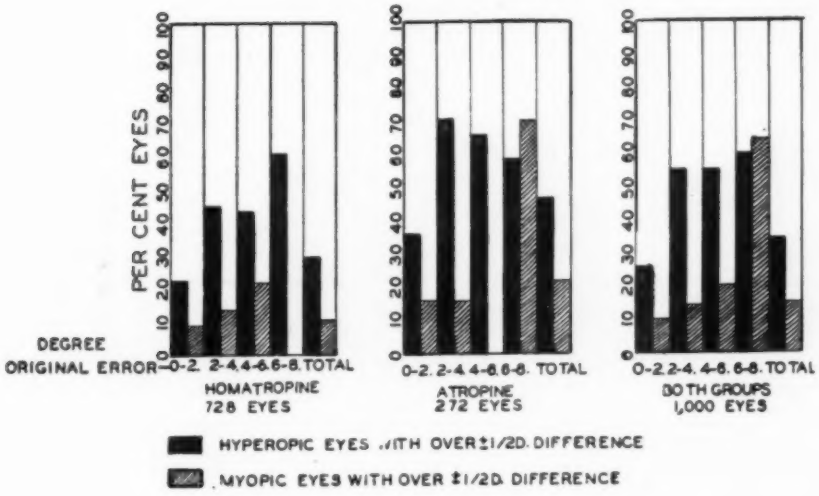
Original Error	Myopia Total No. of Eyes	Myopia Over ± ½ D. Difference: Eyes	Myopia Per Cent	Hyperopia Total No. of Eyes	Hyperopia Over ± ½ D. Difference: Eyes	Hyperopia Per Cent
(ATROPINE—272 EYES)						
0-2 D.	49	8	16	115	42	37
2-4 D.	25	4	16	34	24	71
4-6 D.	3	0	0	24	16	67
6-8 D.	10	7	70	12	7	58
Total	87	19	22	185	89	47
(HOMATROPINE—728 EYES)						
0-2 D.	240	21	9	324	73	23
2-4 D.	51	7	14	51	23	45
4-6 D.	27	6	22	21	9	43
6-8 D.	1	0	0	13	8	61
Total	319	34	11	409	113	28
(BOTH GROUPS—1,000 EYES)						
0-2 D.	289	29	10	439	115	26
2-4 D.	76	11	15	85	47	55
4-6 D.	30	6	20	45	25	55
6-8 D.	11	7	64	25	15	60
Total	406	53	15	594	202	34

6. The percentage of hyperopic cases in which more hyperopia was found under cycloplegia was appreciably greater than the percentage of myopic cases in which less myopia was found under cycloplegia.

7. The greatest degrees of difference between the non-cycloplegic and the cycloplegic findings occurred in the hyperopic cases and especially in the younger patients where atropine was used.

In the opinion of the writer, the foregoing conclusions offer strik-

GRAPH XII
COMPARISON OF CASES WITH MORE THAN ± 1/2D.
DIFFERENCE UNDER CYCLOPLEGIA
ACCORDING TO DEGREE OF ORIGINAL ERROR


PER CENT EYES
0 10 20 30 40 50 60 70 80 90 100
DEGREE ORIGINAL ERROR
0-2. 2-4. 4-6. 6-8. TOTAL
HOMATROPINE 728 EYES
ATROPINE 272 EYES
BOTH GROUPS 1,000 EYES
HYPEROPIC EYES WITH OVER ±1/2D. DIFFERENCE
MYOPIC EYES WITH OVER ±1/2D. DIFFERENCE

ing evidence that *both* the cycloplegic and the fogging techniques give the same findings in the majority of cases. In view of this study the ophthalmologist may find encouragement to depend more upon non-cycloplegic findings, and the optometrist may feel confident that in the vast majority of cases the fogging technique provides essentially the same data as does the cycloplegic method. In those cases where the ametropia findings without and with cycloplegia did not agree, it cannot be concluded that the results from one method are more accurate than from the other. Further study in analyzing the data is necessary to determine to what extent the findings under cycloplegia could be predicted from the non-cycloplegic findings. Of considerable interest are those cases in which more myopia, or less hyperopia, was found under cycloplegia. Furthermore, it is expected that a study of the motility data without and with cycloplegia will prove worthwhile. Papers [36, 37, 38] on these matters are in preparation and will be published in the near future.

The inspiration and guidance of Walter B. Lancaster, M.D., is acknowledged by the author with deepest gratitude.

TABLE XIII

SUMMARY OF CASES WITH MORE THAN ± ½ D. DIFFERENCE UNDER CYCLOPLEGIA ACCORDING TO AGE GROUPS

(ATROPINE—272 EYES)

	Myopia			Hyperopia		
		Over ± ½ D. Difference			Over ± ½ D. Difference	
Age Group	No. of Eyes	Eyes	Per Cent	No. of Eyes	Eyes	Per Cent
0-5 years	2	2	100	22	10	45
5-10 years	27	7	26	80	47	59
10-15 years	58	10	18	83	32	38
Total	87	19	22	185	89	48

(HOMATROPINE—728 EYES)

0-10 years	15	0	0	28	17	60
10-20 years	197	27	14	132	37	28
20-30 years	79	7	9	137	29	21
30-40 years	15	1	7	78	24	30
40-50 years	13	0	0	34	6	18
Total	319	35	11	409	113	28

(BOTH GROUPS—1,000 EYES)

0-10 years	44	9	20	130	74	57
10-20 years	255	37	14	215	69	32
20-30 years	79	7	9	137	29	21
30-40 years	15	1	7	78	24	30
40-50 years	13	0	0	34	6	18
Total	406	54	13	594	202	34

REFERENCES

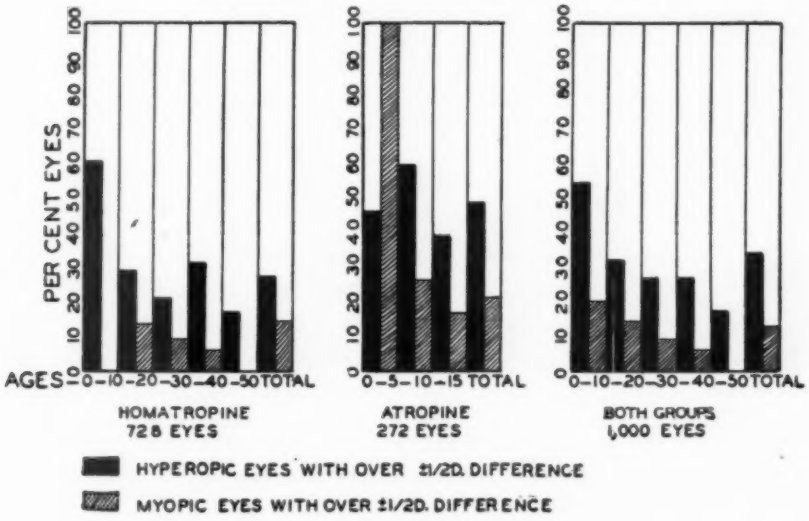
1. Pliny, (Caius Plinius Secundus): Natural History. Boox XXV, Chapter 92, trans. by Bostock, John and Riley, H. T., Vol. 5, Henry C. Bohn, York Street London, 1856, pages 136-138; also abstracted in The Am. Ency. of Ophth., Vol. XIII, page 10276, Cleveland Press, Chicago, 1918.

GRAPH XIII

COMPARISON OF CASES WITH MORE THAN ± 1/20.

DIFFERENCE UNDER CYCLOPLEGIA

ACCORDING TO AGE GROUP



REFERENCES—*Continued*

2. Fluckinger, Friedrich A., and Hanbury, Daniel: Pharmacographia, A History of the Principle Drugs of Vegetable Origin, second edition, MacMillian and Company, London, 1879, pages 456-458.
3. Wells, William Charles: Observations and Experiments on Vision, Phil. Trans. Royal Acad. of London, 1811, pages 378-391.
4. Donders, F. C.: On The Anomalies of Accommodation and Refraction of The Eye. New Sydenham Soc., London, 1864, 635 pages.
5. Lancaster, Walter B.: The Story of Asthenopia. Arch. Ophth., 30 (2), August 1943, pages 167-178, Lloyd, Ralph I.: History of Eyeglasses, Guildcraft, June-July 1942.
6. Landolt, E.: The Refraction and Accommodation of The Eye and Their Anomalies. J. B. Lippincott Company, Philadelphia, 1886, 597 pages.
7. Examination Under Atropine of Refractive State of Eyes with Normal Vision, trans. Am. Ophth. Soc., 2 (4), 1878, pages 462-466.
   Homatropia in Refractive Cases, Am. J. Ophth., 8: 221, 1881.
   Hydrobromate of Homatropine, Am. J. Ophth., 3: 199, 1886.
   Some Disputed Points in the Correction of Refractive Errors, Am. J. Ophth., 8: 38, 1891.
8. Chisholm, Julian J.: Homatropia in Refractive Cases, Am. J. Ophth., Vol. 8, July-August, 1891, pages 221-222.
9. Howe, Lucien: The Muscles of The Eye, Vol. II, G. P. Putnam's Sons, New York, 1908, pages 34-38.

TABLE XIV
SUMMARY OF DIFFERENCES IN ASTIGMATISM FOUND UNDER CYCLOPLEGIA
CYLINDER

Amount of Change c Cyclo.	Atropine My. Eyes	Per Cent	Atropine Hy. Eyes	Per Cent	Homat. My. Eyes	Per Cent	Homat. Hy. Eyes	Per Cent	All Groups Eyes	Per Cent
− 2.00 D.	0	0	0	0	1	0	1	0	2	0.2
− 1.50 D.	0	0	0	0	1	0	1	0	2	0.2
− 1.00 D.	1	1	4	2	2	1	5	1	12	1.2
− 0.75 D.	1	1	3	2	1	0	6	1	11	1.1
− 0.50 D.	12	14	16	9	14	5	27	7	69	6.9
− 0.25 D.	18	21	15	8	61	19	79	19	173	17.3
0.00 D.	41	47	109	59	171	54	211	52	532	53.2
+ 0.25 D.	7	8	26	14	53	17	54	13	140	14.0
+ 0.50 D.	5	6	8	4	13	4	19	5	45	4.5
+ 0.75 D.	1	1	1	½	0	0	2	1	4	0.4
+ 1.00 D.	1	1	1	½	1	0	4	1	7	0.7
+ 1.50 D.	0	0	0	0	1	0	0	0	1	0.1
+ 2.00 D.	0	0	1	½	0	0	0	0	1	0.1
+ 2.50 D.	0	0	1	½	0	0	0	0	1	0.1
Total	87	100	185	100	319	100	409	100	1000	100.0

AXIS

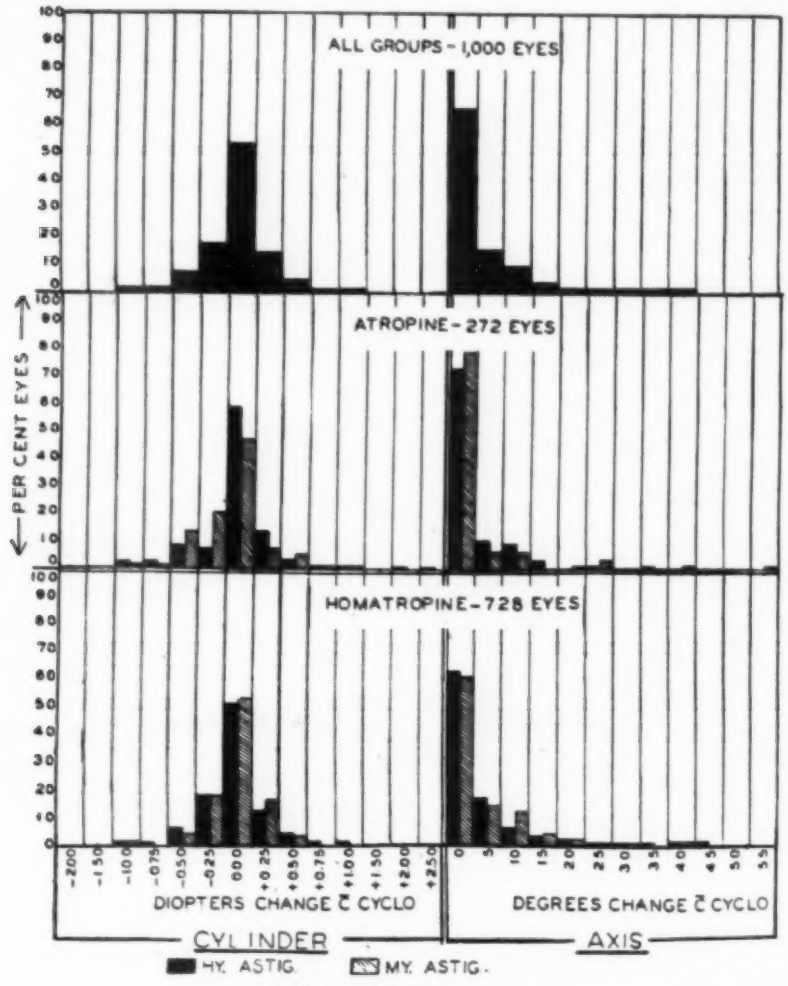
Degrees of Change c Cyclo.	Atropine My. Eyes	Per Cent	Atropine Hy. Eyes	Per Cent	Homat. My. Eyes	Per Cent	Homat Hy. Eyes	Per Cent	All Groups Eyes	Per Cent
0	69	79	136	73½	199	62	262	64	666	66.6
5	6	7	21	11	48	15	77	18	152	15.2
10	6	7	18	10	39	13	28	7	91	9.1
15	0	0	7	4	14	5	17	4	38	3.8
20	1	1	0	0	7	2	7	2	15	1.5
25	3	4	1	½	4	1	3	1	11	1.1
30	0	0	0	0	4	1	5	1	9	0.9
35	0	0	2	1	0	0	5	1	7	0.7
40	1	1	0	0	3	1	3	1	7	0.7
45	0	0	0	0	0	0	2	1	2	0.2
50	0	0	0	0	1	0	0	0	1	0.1
55	1	1	0	0	0	0	0	0	1	0.1
Total	87	100	185	100	319	100	409	100	1000	100.0

REFERENCES—*Continued*

10. Souter, William Norwood: The Refractive and Motor Mechanism of the Eye. The Keystone Publishing Company, Philadelphia, 1910, page 206.
Pannell, W. L.: Some Non-Cycloplegic Methods of Refraction. Ophth. Essays, Abstracts, and Reviews. 21 (1-4). October 14, January, April, July 1915, pages 770-773.
Lancaster, Walter B.: Subjective Tests for Astigmatism, Especially Astigmatic Charts. Tr. Am. Acad. Ophth. and Otol., October 1915, pages 167-191.
Smith, Dorland: The Estimation of The Total Refractive Error Without A Cycloplegic. Trans. Am. Acad. Ophth. and Otol., 1930, pages 101-127.
Regan, James J.: Refraction Without Cycloplegic. Sect. on Instruction. Am. Acad. Ophth. and Otol., 1944, pages 23-30.
11. Crisp, William H.: Shall We Use Cycloplegics? Am. J. Ophth., 22 (4) 1939, pages 392-398.

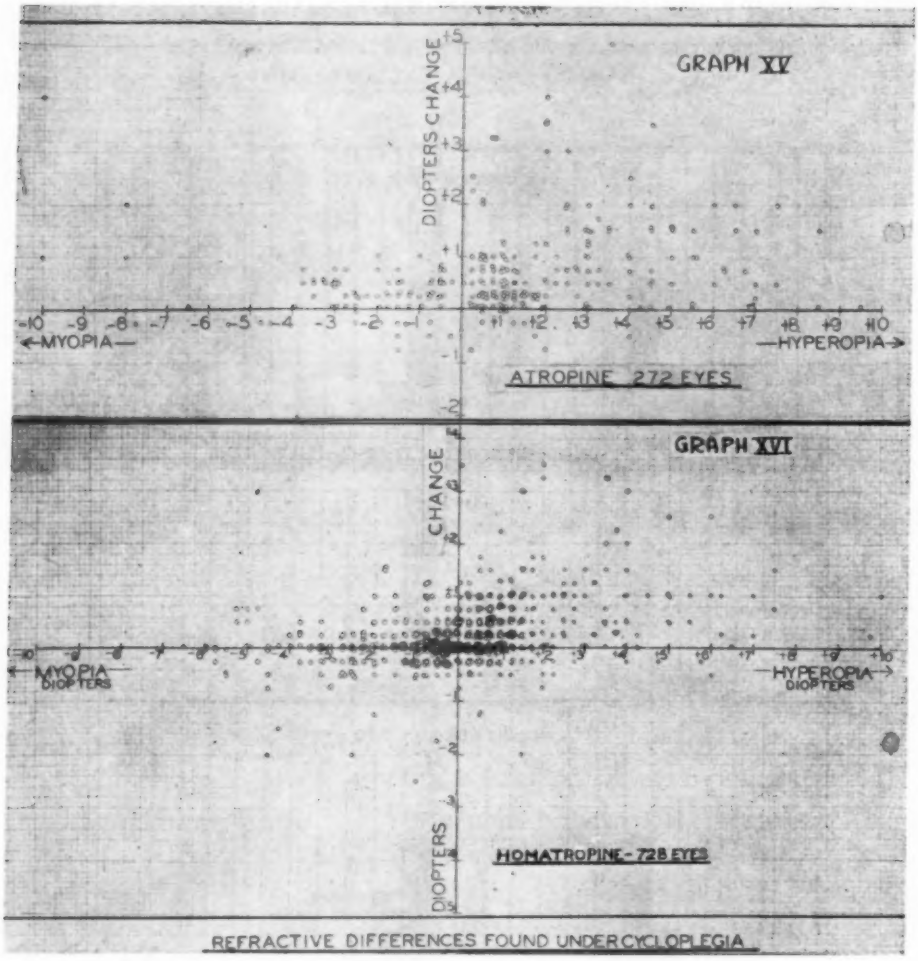
GRAPH XIV

SUMMARY OF DIFFERENCES IN ASTIGMATISM
FOUND UNDER CYCLOPLEGIA



REFERENCES—*Continued*

12. Mein—See Chapter 25 in Goodman, Louis, and Goodman, Alfred: The Pharmacological Basis of Therapeutics, The Macmillan Company, New York, 1941, 1383 pages.
13. Myerson, Abraham and Thau, William: Human Autonomic Pharmacology, Arch of Ophth., 18 (1) July 1937, pages 78-90.
14. Beach, S. Judd and McAdams, W. R.: Benzedrine in Cycloplegia, Am. J. Ophth., 21 (2), February 1938, pages 121-124.
15. Powell, L. S. and Hyde, M. E.: The Effects of Benzedrine Sulfate Solution on Cycloplegia, Jour. Kansas Med. Soc., January 1938.



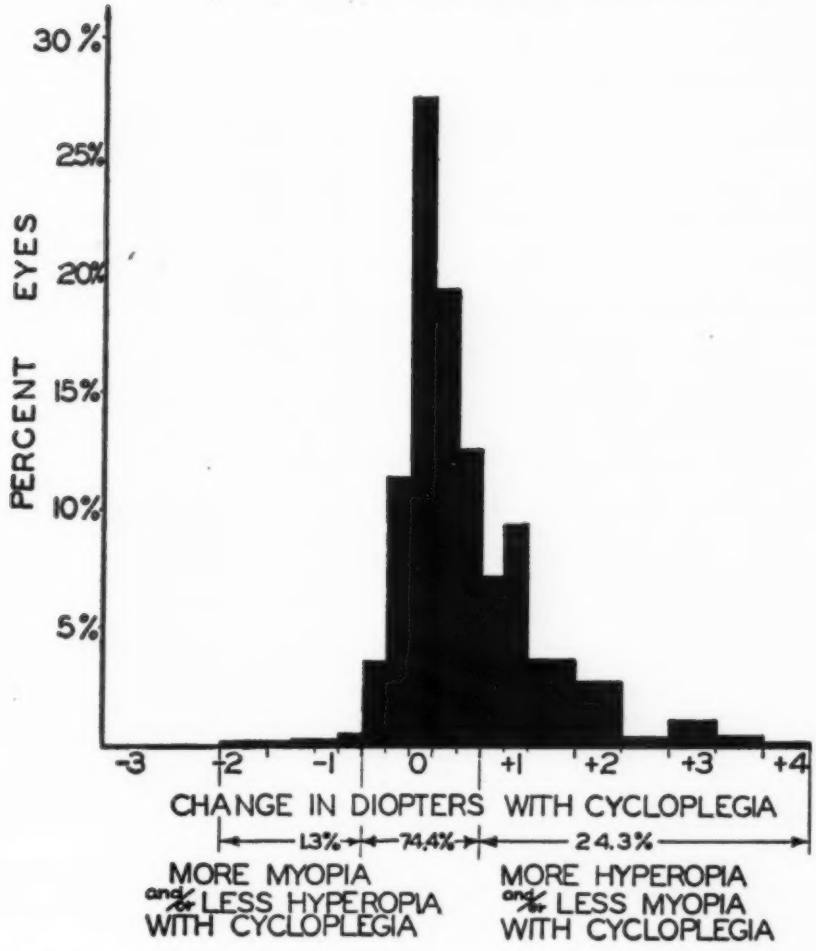
REFERENCES—*Continued*

16. Tassman, J. S.: Use of Paredrine in Cycloplegia, Am. J. Ophth., 21 (9), September 1938, pages 1019-1024.
17. Prangen, Avery De H.: What Constitutes a Satisfactory Cycloplegia?, Am. J. Ophth., Series 3, Vol. 14, 1931, pages 665-671.
18. Thorne, Frederick Hamilton and Murphy, Henry S.: Cycloplegics, Arch. Ophth., 22 (2), August 1939, pages 274-287.
19. Weneas, E. J., Evans, Witt., and Odom, R. E.: A Study of Practical Cycloplegia, with Special Reference to the Use of Paredrine, 341 Cases, Am. J. Ophth., Series 3, Vol. 23, 1940, pages 1123-1135.
20. Freire, Americano S. and Rocha, H.: Hydrochloride of Benzyloil-Diethylamino-Ethanol (Cycloplegina) as Cycloplegic, Mydriatic, and Local Anesthetic, Ophthalmos, Vol. 3, No. 3, 1944, pages 287-310.
21. Swan, K. C. and White, N. G.: Dibutoline Sulphate (A New Mydriatic and Cycloplegic Drug), Arch. Ophth., 33 (1), January 1945, pages 16-22.

GRAPH XVII

SUMMARY OF DIFFERENCES FOUND UNDER CYCLOPLEGIA

(ALL GROUPS COMBINED, 1000 EYES)



REFERENCES—*Continued*

22. Butler, Harrison T.: Refraction Without Cycloplegics. Trans. Ophth. Soc. of the United Kingdom, Vol. XLII, Session 1922, London, pages 127-147.
23. Burdon-Cooper, J.: The Behaviour of the Crystalline Lens System in Artificial Cycloplegia and its Influence on the Refraction of the Eye. Trans. Ophth. Soc. of the United Kingdom. Vol. XLV, Part I. 1925, pages 386-392.
24. Duke-Elder, Stewart: The Practice of Refraction. The Blakiston Company, Philadelphia, 4th edition. 1943, 328 pages.

TABLE XVIII

SUMMARY OF PRESCRIPTIONS GIVEN

	Rx Based on Non-Cyclo Findings		Rx Based on Cyclo Findings		Rx Halfway Between the Two Findings		Totals	
Hyperopic Eyes	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
(a) Atropine	86	65	27	20	20	15	133	100
(b) Homatropine	206	62	80	23	51	15	337	100
Myopic Eyes								
(a) Atropine	28	39	35	50	8	11	71	100
(b) Homatropine	139	57	84	34	24	9	247	100
Totals	459	58	226	29	103	13	788	100

REFERENCES—*Continued*

25. Lancaster, Walter B.: Subjective Tests for Astigmatism, Especially Astigmatic Charts, Trans. Am. Acad. Ophth. and Otol., October 1915, pages 167-191.
26. Lancaster, Walter B.: Practical Physiological Optics. Continuous Course No. 6, Graduate Lectures, Am. Acad. of Ophth. and Otol., 1943.
27. Smith, Dorland: The Estimation of The Total Refractive Error Without a Cycloplegic, Trans. Am. Acad. of Ophth. and Otol., 1930, pages 101-127.
28. Kurtz, J. I.: A Comparative Study of Refraction With and Without a Cycloplegic. Trans. Am. Acad. Optom., Vol. 7, 1933, pages 74-97.
29. Tait, Edwin Forbes and Sinn, Frederick William: A Preliminary Report on The Variations in Ciliary Muscle Tonus with Use of Homatropine, Trans. Am. Acad. Optom., Vol. 9, 1935, pages 76-83.
30. Betts, Emmett A., and Austin, Agnes Sutton: Visual Problems of School Children, The Optom. Weekly, Professional Press, Chicago, 1940-1941.
31. Hunt, William T., Jr., and Betts, Emmett A.: Visual Problems: Certain Assumptions and Data, Am. J. Ophth., 25 (9), September 1942, pp. 1084-1094.
32. Seigneur, William Beau: Cycloplegic Refractions—Results in 1,000 Cases. The Optom. Weekly, June 13, 1946.
33. Lancaster, Walter B.: Subjective Tests for Astigmatism, Especially Astigmatic Charts: Trans. Am. Acad. Ophth. and Otol., Oct. 1915, pp. 167-171.
    Regan, James J.: Astigmatic Dials in Refined Refraction. Arch. Ophth., May 1937, 17, pp. 788-796.
    Bannon, Robert E., and Walsh, Rita: On Astigmatism, Part III—Subjective Tests, Am. J. Optom. and Arch. Am. Acad. Optom., May 1945.
    Bannon, Robert E., and Walsh, Rita: Objective and Subjective Tests for Astigmatism. Opt. J. and Rev. of Optom., Nov. 1, 1945.
34. Tscherning, M.: Physiological Optics, The Keystone Publishing Co., Philadelphia, 1920.
35. Mitchell, D. W. A.: The Use of Drugs in Refraction, The Hatten Press, Ltd., London, 1946.
36. Miles, Paul W.: Paradoxical Accommodative Effect in Cycloplegic Refraction. Am. J. Ophth., to be published.
37. O'Brien, James Miles, and Bannon, Robert E.: A Critique of non-Cycloplegic Refraction. Arch. Ophth., to be published.
38. Bannon, Robert E.: Effects of Cycloplegia on Motility Data. Am. J. Optom. and Arch. Am. Acad. Optom., to be published.

GRAPH XVIII

SUMMARY OF PRESCRIPTIONS GIVEN

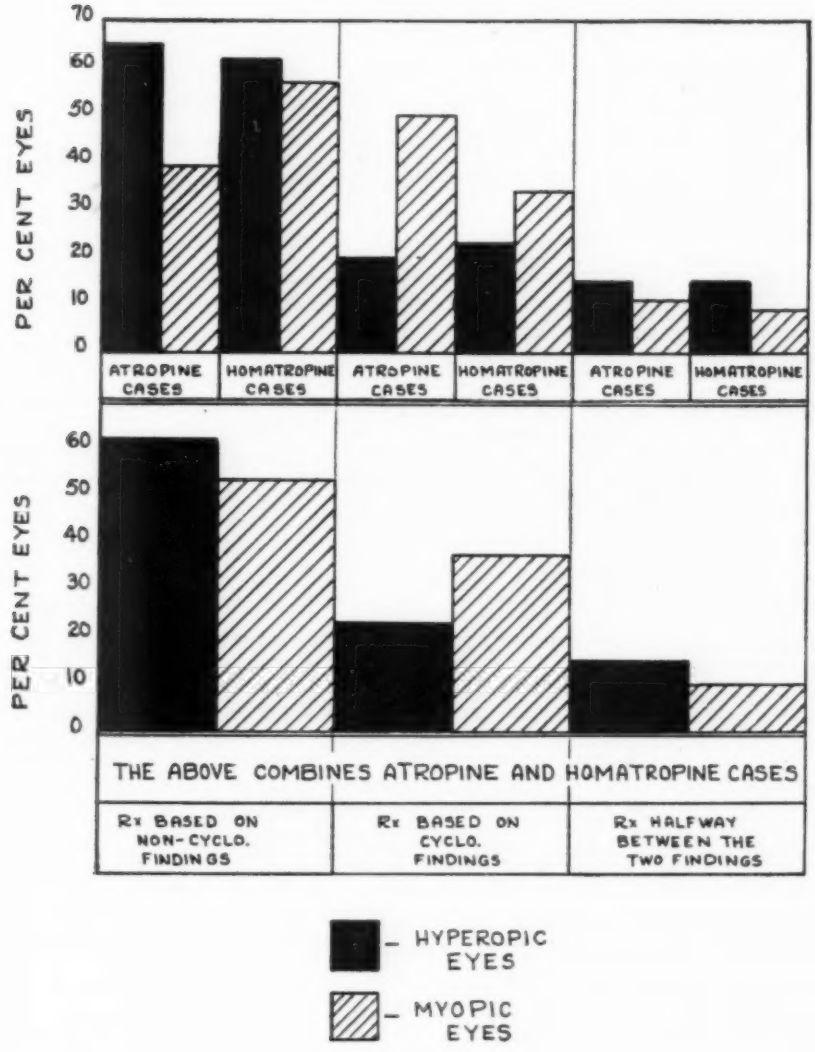
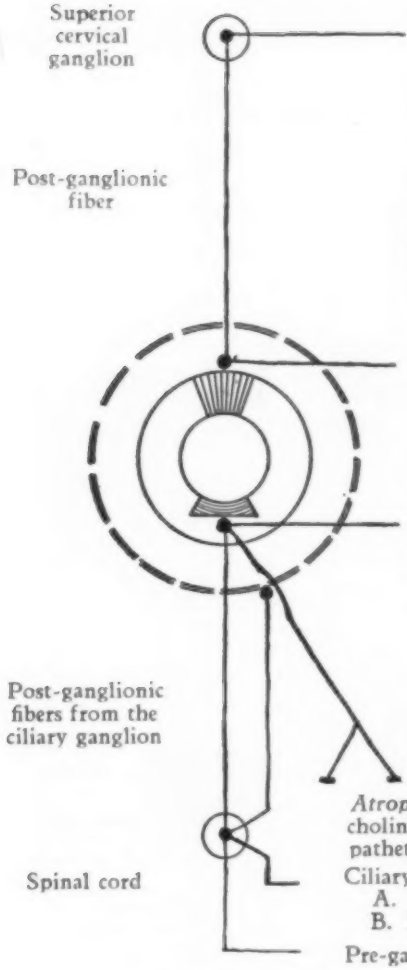


FIGURE 1

INNERVATIONAL COMPONENTS OF
IRIS AND CILIARY BODY



Pre-ganglionic fibers from spinal cord.

Sympathetic dilator control, acting by releasing adrenalin-like substance at myo-neural area, directly stimulating dilator muscle.

Sympathomimetic drugs:

Adrenalin, Paredrene, Benzedrine } These drugs enhance action of adrenalin-like substance at myo-neural junction.

Myo-neural junction of sympathetaic nerve and dilator muscle.

Myo-neural junction of parasympathetic nerve and constrictor muscle.

Parasympathetic - constrictor control, acts by the release of acetyl choline at myo-neural area.

Parasympathetic drugs:

(Eserine and its allies) These drugs act by increasing the activity of acetyl choline present. (Preserve it from being destroyed.)

Atropine and its allies act here by destroying acetylcholine present in myoneural area, thus allowing sympathetic dilator control to act with no inhibition.

Ciliary muscle thought to be controlled by
A. Sympathetic stimulation ±
B. 3 Nerve inhibition and stimulation ±

Pre-ganglionic fibers from spinal cord.

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DESQUAMATION OF THE CORNEA RESULTING FROM A CONTACT LENS WEARING PERIOD OF ONE AND ONE-HALF DAYS' DURATION—A CASE REPORT*

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Recently it was reported verbally to the writer, with the implication that the information was fairly new and not well known, that temporary corneal damage can occur as a result of softening of the corneal epithelium occurring with the development of corneal clouding while wearing a contact lens. The following case report may add useful information to the body of knowledge on this topic.

In November, 1942, the writer was making some exploratory use of a trial set with lenses similar to the plastic-glass lenses which were probably the most commonly employed trial lenses at that time. One patient (C. McC.) obtained a fairly satisfactory fit with the best of these lenses, with the limbal clearance good horizontally and inferiorly, but rather narrow superiorly. No corneal contact was present with the eye in the straight forward position, or with rotation. This lens was usefully wearable for periods up to four hours, with corneal clouding the limiting factor, rather than any feelings of discomfort or irritation.

The patient was quite interested in the general problem of wearing time and had done some reading on this topic. On his own initiative, and contrary to specific instructions, he decided to see how long he could tolerate the lens. It was inserted at 11:00 p. m. on December 1. The next morning, after eight hours, the patient noted a broad spectrum concentric with bright objects. After fifteen hours the spectrum was still noticed, but general fogging or haziness was pronounced. After twenty hours the spectrum was much less noticeable, and the fog was somewhat increased.

The following morning, December 3, about 32 hours after insertion, the patient found the spectrum entirely gone, with the fog increased to such an extent that it was difficult to distinguish shapes of familiar objects. At 12 m. the same day he removed the lens, and noted that it was difficult to distinguish his fingers at arm's length. No symptoms of discomfort were present, and the lens was reinserted.

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†Optometrist. Member of faculty. Fellow, American Academy of Optometry.

At 2:00 p. m. the patient came to the laboratory, apparently to report on the length of time he had worn the lens. Perhaps he was beginning to wonder a little about his procedure, but at least he did not come in seeking any assistance.

His eye through the lens appeared to have an almost opaque gray cornea. The lens was removed, to the accompaniment of remonstrances at his procedure, and this time the patient immediately experienced pain localized in the cornea, particularly with the eye open.

The patient was given ophthalmological attention. Fluorescein was used to test for epithelial erosion. Almost the whole surface of the cornea was stained, indicating almost complete loss of the surface epithelial cells. The following day epithelization was nearly complete and restoration of the normal cornea occurred uneventfully. Since this time, this individual has worn contact lenses for four to five hour periods, twice a day, with excellent results.

The outcome described above is, of course, an extreme example of what may happen as a result of a prolonged wearing period. Ordinarily the lens would not be worn beyond the period of useful vision, and consequently this case presents no basis for expecting similar results under normal conditions. Nevertheless, the case does support the view that corneal clouding is evidence of a fundamental temporary change in the corneal epithelium which, if permitted to develop sufficiently during any one period of wear, will render the cornea more susceptible to abrasion. The practice of limiting the wearing period to an hour or two after the first development of corneal haze seems justified until more is learned about the course of development of this susceptibility

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THE OBJECTIVES OF AN INDUSTRIAL EYE CARE PROGRAM

Arguments and apprehension over the Taft-Hartley labor bill, strikes and retarded production, make page one daily in the metropolitan press of the country, yet generally in industry wheels are turning and something more than a fair measure of production is being achieved. Actually the apparent unrest, while acute in spots, is by no means as widespread as some sensational press writers would have us believe.

In many industries management and labor are cooperating. These industries are overcoming their war period handicaps and are now producing materials and goods in such quantities as to rapidly meet consumer demand. In these industries will be found the greatest interest in programs dealing with industrial vision. Here both management and

labor can study their respective roles and assess the value to them of a professionally conducted eye care program for their plant.

To be effective the program must benefit both management and labor and must have a true tinge of altruism. In order to succeed it must have the wholehearted support of both groups and to secure this support it must make a contribution to the well being of the worker as well as to the dividend received by the stockholder.

Can an industrial vision program meet this requirement? We believe it can, and we further believe that properly trained optometrists can make significant contributions towards its success.

Let us first review the worker's initial attitude towards an industrial vision program. When the subject is first broached he is apt to be resentful and sometimes fearful of the new idea. In this he is no different than optometrists are when confronted with new ideas. Is this a new dodge on the part of management to regiment him and control his liberties, the worker wonders. Is this a program set up to separate him from his job? Is the program a foil on the part of management to speed up production and thus reduce the total number of workers? Is this program just the front for another industrial time-study put on by some so-called efficiency expert? We know it is none of these things, but the worker does not know. The program has little chance for success unless these fears are carefully and thoroughly set aside.

Before the program is put into effect, this should be done with small groups of workers at conferences, one department after the other, until all have been reached. The conferences can be held at special periods or at the noon hour. Here the optometrist and the plant superintendent or some other official should informally discuss all phases of the program in a candid manner, stressing that it is none of the foregoing, and that like a retirement plan it will in time improve working conditions and add to the worker's living comforts, improve his efficiency, and protect him from possible eye injury.

It might be well, too, at these conferences to point out that the plan is not a spectacle selling scheme or a program devised to put glasses on most of the staff. The optometrist should also stress the fact that the program is not devised to enable the worker to secure all ophthalmic products at laboratory prices.

In short, the industrial vision program will assist in keeping the worker's efficiency at a high level, thus improving his confidence and help keep up his morale. In other words, it will assist in making him happier at his work and at the same time eliminate the fear of eye in-

juries which might occur. The factors of greater working comfort and freedom from accidents should be stressed and sold the workers.

From the viewpoint of management, if the plan is to succeed, their attitude must follow the following pattern. First, there must be a real desire on the part of the employer to contribute something tangible to the worker's well being. Like a retirement program, management will get out of the program in benefits just about what it puts in. If the plan is devised to really make working conditions better and to improve the health and happiness of the worker it has a very good chance of success.

Second, management must approve the program and get it into operation on a long term basis. A single, one-time-over, visual survey is almost worthless.

Third, management must be willing to give the optometrist the time, place and technical help with which to work. The program is important and cannot be done quickly. If effective, it will cost management rather materially in the way of funds.

On the other hand, management, too, will have some rather tangible benefits from a properly conducted program of visual care. These are, (1) fewer man hours lost through visual fatigue and eye injuries, (2) greater visual efficiency resulting in at least a reduction of spoilage, (3) reduced compensation insurance rates due to a lessened accident ratio, and (4) a reduction in labor turnover caused by the correction of faulty and unpleasant working conditions.

This is true providing the plan is operated to meet the three minimum requirements of an industrial vision program. These requirements are, first, the optometrist must exercise control and immediate supervision of the visual survey. While lay technicians or nurses may report the findings, the actual screening of each worker should be supervised by a professionally trained optometrist. Second, following the initial screening, the interpretation of the findings must be made by the industrial optometrist who is qualified to pass judgment on these cases. This optometrist must also be available for personal conference with the workers selected for additional visual care should they wish to discuss their problem with him. Third, the legitimate aims of the program must be followed by the staff. These include increasing efficiency, visual care, safety and proper job placement for the worker with sub-normal vision.

Optometrists who are skilled in industrial eye care should now press forward with these programs. Industrial profits are in general high, and in most industries a well tailored program for the industry will receive careful attention. Good visual screening equipment is available

from several sources. In the hands of the trained professional optometrist this equipment will produce results of value to both the worker and to management. The year ahead should show a marked upsurge in the optometric program of visual care in industry. CAREL C. KOCH

CORRESPONDENCE

THE ANGLE OF DEVIATION IN CONCOMITANT SQUINT

TO THE EDITOR:

The following is a comment in regard to Dr. H. W. Hofstetter's paper, "Certain Variations in the Angle of Deviation in Concomitant Squint."*

In this paper Dr. Hofstetter mentions an exotrope who apparently had voluntary control of the angle of squint. The method of determining the presence or absence of accommodation, according to Dr. Hofstetter, was by the subject's continuous reports of ability to read letters corresponding to their maximum acuities, as evidence that the actual accommodation was at least approximately equal to the stimulus value at all times.

It has been my experience to observe a squint with a low maximum acuity who had a change in accommodation, as determined by the retinoscope, accompanied by a change in the angle of squint, and yet no change in the level of maximum acuity was observed by the patient.

It would seem possible to me in view of the above that the exotrope mentioned by Dr. Hofstetter who had voluntary control of the variation in the angle of squint might be exercising accommodative-convergence to change his angle of squint. At least it appears to me that a more specific explanation of what the maximum acuity is in this case would be important in determining its proper classification, unless accommodation was ruled out by some means of objective observation, such as retinoscopy.

ROBERT C. BAXTER, JR.
203 LINCOLN BLDG.
WARREN, OHIO

*Henry W. Hofstetter. Certain Variations in the Angle of Deviation in Concomitant Squint. Am. J. Optom. & Arch. Am. Acad. Optom. 24:10. 463-471. 1947.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

RECEPTION ROOM FAUX PAS

The doctor was refracting his patient. As he made his ophthalmoscopic examination, he could hear his receptionist chattering to the patient's husband who was waiting outside in the reception room.

"Oh, yes, I always take a plane when I travel," the receptionist was saying. "I haven't ridden a train since my first trip in an airplane. Trains are so slow and dirty."

Her tone was friendly, and the doctor knew she was doing her best to make the husband (also a patient) feel at home. What the receptionist didn't know was that she was talking to a man who had worked for a major railroad for 22 years, and who thought nothing could compare with a train.

The patient may or may not have resented the girl's remark. There is a possibility, however, that he did. And if he did, the seemingly innocent remark may have spoiled to a degree the friendly relations so carefully built up by the doctor.

Or take the girl who kept a patient waiting while she painted her fingernails in the inner office, finally emerging, waving her hands to dry the polish while she greeted the caller.

Both the above incidents actually took place in an optometrist's office. Either may have annoyed the patient sufficiently so that he or she felt like going elsewhere for the next eye examination, no matter how skillful the doctor. Human nature is funny that way.

The optometrist can avoid such situations in two ways. He can take time to give the receptionist a tip on the patient's background if known so that she won't unknowingly say the wrong things; he can set efficiency standards high, and let his receptionist know he expects her to live up to them. A girl can do it if she knows her job depends upon it!

A great deal has been written about the importance of the optometrist having a good "chairside manner." More should be written about the importance of selecting a receptionist who can combine efficiency with an understanding of human nature, and who makes it her business to say the right thing at the right time.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ACADEMY TO MEET IN CHICAGO

Colonel O. F. Goriup, Chief of the Medical Service Corps, United States Army, Washington, D. C., will be the speaker at the formal annual round table dinner of the American Academy of Optometry, Palmer House, Chicago, on Monday, December 15. Colonel Goriup will be presented to the Academy by Fellow Dr. Ward H. Ewalt, Jr., of Pittsburgh, who has recently been appointed Optometrical Advisor for the United States Army. Dr. Harold M. Fisher, Mt. Kisco, New York, President of the Academy, will preside at the banquet.

Dr. Harold Simmerman, Woodbury, New Jersey, assisted by the following members of the Program and Papers Committee; Drs. Julius Neumueller, Henry Hofstetter, Eugene Freeman and Arthur R. Neale, announce the following speakers will present original papers at the four-day session which will start with registration Saturday morning, December 13, 1947.

The Academy sections on orthoptics, contact lens fitting and aniseikonia will hold special sessions, of two hours each, on Sunday, Monday and Tuesday in special quarters set aside for this purpose at the Palmer House. These sessions will run concurrently and will be open to all members of the Academy.

Mathew B. Alpern, O.D. "Accommodation and Convergence with Contact Lenses." Cleveland, Ohio.

Charles S. Bridgman, O.D. "A Summary of Current Designs For and Techniques of Fitting Contact Lenses." Columbus, Ohio.

Paul Boeder, O.D. "Recent Developments in Space Perception." Southbridge, Massachusetts.

I. M. Borish, Ph.D. "Prism Corrections—A Clinical Report on 147 Cases." Kokomo, Indiana.

Vincent J. Ellerbrock, Ph.D. "Further Study of the Effects Induced by Anisometropic Corrections." Columbus, Ohio.

Leon A. Firestone, O.D. "Contact Lenses and Their Effect on Neuro-Muscular Patterns of Vision." Detroit, Michigan.

Eugene Freeman, Ph.D. "The Method of Science." Chicago, Illinois.

Glenn A. Fry, Ph.D. "Spatial and Temporal Characteristics of Interaction Between Retinal Cortical Pathways." Columbus, Ohio.

Norman B. Hays, O.D. "Vertical Phorias." Niagara Falls, New York.

Monroe J. Hirsch, Ph.D. "Notes on Ametropia—A Further Analysis of Stenstrom's Data." Columbus, Ohio. This material was co-authored with Dr. Frank W. Weymouth of the Department of Physiology, School of Medicine, Stanford University, California.

J. D. Kratz, O.D. "The Clinical Value of the Abduction Finding." Philadelphia Pennsylvania.

Roy Marks, O.D. "Some Factors for Consideration in the Prescribing and Fitting of

Telescopic Spectacles for Sub-Normal Vision." Dayton, Ohio.
Herbert G. Mote, O.D. "Changes in Static Refraction of a Diabetic as the Blood Sugar Varies." Columbus, Ohio.
Julius Neumueller, O.D. "The Correction Lens." Philadelphia, Pennsylvania. This paper will be presented in two parts.
Frederick Sinn, O.D. "Chromatism in Bifocal Segments." Philadelphia, Pennsylvania.
William W. Walton, Jr., O.D. "Cyclo-Torsion Effects Produced by Head Tilting." Philadelphia, Pennsylvania.
Ralph E. Wick, O.D. "Scleral Tonometry and Its Optometrical Application." Rapid City, South Dakota.

The Academy will hold two short business meetings while at Chicago. The first, Saturday morning, to receive reports, the second, Monday afternoon, to elect officers and consider routine Academy affairs.

The examining board, consisting of Dr. Richard M. Hall, Cleveland, Ohio, chairman, and Drs. Don R. Paine, Topeka, Kansas; M. T. Eberl, Milwaukee, Wisconsin; Arthur P. Wheelock, Des Moines, Iowa; Elmer E. Hotaling, New York City, and Dr. Ernest E. Hutchinson, Los Angeles, California, will meet to examine applicants who have been notified to be present. The examinations will take place on the campus of the Northern Illinois College of Optometry.

A special luncheon for presidents and secretaries of the local chapters will be held by the Executive Council, Sunday noon. Each chapter will present a short report of its activities since the Philadelphia meeting in May.

A detailed program of the four-day session will be mailed to each member of the Academy.

CAREL C. KOCH

FALL CHAPTER ACTIVITIES

NEW CHAPTER ORGANIZED IN NORTH CAROLINA

The fourteenth chapter of the American Academy of Optometry was organized in October, 1947, by North Carolina Academy members. The first meeting of the group was held Sunday, October 5, 1947, with Dr. Robert N. Walker, Winston-Salem, acting as temporary chairman.

Following a talk by Dr. Walker outlining the aims of the Academy, members listened to an original paper, "New Approaches to Bichrome Refraction." Discussion followed presentation of this paper.

Officers elected to serve for the first year were: Dr. Robert N. Walker, president; Dr. T. E. Donoghue, Wilson, vice-president; and Dr. John D. Perry, Jr., Winston-Salem, secretary-treasurer. These officers and the two following members will serve on the executive council of the chapter: Dr. James O. Baxter, Jr., Beaufort, and Dr. T. E. Holleman, Winston-Salem.

Dr. Baxter invited the chapter to meet in Beaufort at its next meet-

ing, and the invitation was unanimously accepted.

Tentative plans were made by the chapter to charter a Pullman car for the North Carolina delegates going to the annual meeting of the Academy in Chicago in December.

Charter members of the new North Carolina chapter are: Drs. J. O. Baxter, Beaufort; D. L. Calhoun, Forest City; John T. Campbell, Washington; Horace Carpenter, Rutherfordton; Jule S. Deans, North Wilkesboro; Henry B. Day and Henry B. Day, Jr., Raleigh; Thomas Donoghue, Wilson; P. W. Green, Mt. Airy; John T. High, Rocky Mount; T. E. Holleman, Winston-Salem; Mordecai Katzin, Winston-Salem; G. L. Lang, Concord; J. Smith Nifond, Greensboro; W. W. Parker, Lumberton; R. J. Pearce, Greensboro; John D. Perry, Jr., Winston-Salem; E. O. Roland, Brevard; John R. Schafer, Statesville; H. M. Seaver, Asheville; Nat Walker, High Point; R. N. Walker, Winston-Salem, and Lee M. Wheless, High Point.

IOWA CHAPTER

Lectures by the staff of the Wolfe Clinic, Marshalltown, highlighted the program of the Iowa Chapter fall meeting. Recognizing the need for constant "brushing up" on properly diagnosing diseases of the eye, the executive council of the Iowa Chapter asked the medical men of the clinic to outline methods of diagnosis of eye difficulties. Lectures on refracting the aphakic eye also were given.

The two-day session, which included a banquet, was held November 3-4, 1947 at the Tallcorn Hotel, Marshalltown.

INDIANA CHAPTER

Four papers were presented to members of the Indiana Chapter who attended the fall meeting October 8, 1947. Dr. T. R. Murroughs, Linton, spoke on the "Modern Approach to the Squint Problem, with Emphasis on the Brock Technique"; Dr. I. M. Borish, Kokomo, presented an "Analysis of 147 Prism Cases"; Dr. J. R. Shreve, Indianapolis, talked on "Elimination of Cyclophoria as a Factor in Astigmatic Correction," and Dr. D. W. Conner's subject was, "Contact Lenses: Indications and Limitations."

The meeting was held at the Severin Hotel, Indianapolis in the afternoon—a time of day which met with favorable comment from many of the attending members.

SOUTHERN CALIFORNIA CHAPTER

A round table discussion of myopia, and the Baltimore Project in particular, took place at the fall meeting of the Southern California

chapter. Dr. Robert Graham, Pasadena, led the discussion. Guest speaker of the evening was Dr. A. R. Lauer, of the department of psychology, Iowa State college.

One new member, Dr. E. L. Ferris, was voted into the chapter. Members also appointed a new examining committee to carry out examining procedure outlined by the Academy at the Philadelphia annual meeting. Elected to serve on this committee were Drs. O. T. Weigmann, Los Angeles; R. M. Swain, Inglewood, and Robert Graham, Pasadena.

NEW JERSEY HOLDS INDUSTRIAL VISION PROGRAMS

A program to "top all occupational vision programs" is now well under way in New Jersey. Sponsored jointly by the New Jersey Chapter of the Academy and the New Jersey Optometric Association, the agenda calls for a series of monthly meetings on industrial eye care which will run through May, 1948. Three of the meetings have already been held, on September 10, October 8, and November 12.

Every phase of industrial eye care is being discussed by industrial authorities. Drs. Julius Neumueller, Harold Simmerman, Matthew Luckiesch, and John R. Wittekind of the American Academy of Optometry are among the lecturers.

Each man attending is given copies of the speeches, so that ultimately he will have a complete reference manual on industrial optometry. Optometrists attending at least 90 per cent of the lectures will be awarded a certificate from the State of New Jersey, stating that he or she is a visual consultant for industry.

ANNOUNCEMENTS

TEMPLE UNIVERSITY

READING CLINIC INSTITUTE

Temple University's 1948 reading clinic institute will begin January 26, 1948. Special attention will be given to visual readiness for reading at this week-long institute on corrective and remedial reading.

Optometrists wishing to attend must enroll in advance, and the registration must be confirmed by the Institute. Dr. Emmett A. Betts, director of the reading clinic, will furnish further information on request. Address Dr. Betts at Temple University, Philadelphia 22, Pennsylvania.

BOOK NOTICES AND REVIEWS

Books received are acknowledged by notices in this department. Special selections will be made for more extensive review in the interest of our readers as space permits.

THE ANALYSIS AND INTERPRETATION OF SYMPTOMS.

Edited by Cyril M. MacBryde. Published by the J. B. Lippincott Company, Philadelphia, Pennsylvania. 301 pages. Cloth. 1944.

This book is a collection of ten monographs from CLINICS, Vol. II, No. 6, April 1944. The authors include some of the most outstanding research workers and distinguished clinicians in American medicine.

Of special interest to optometrists should be the introduction, the chapter on nervousness and fatigue, and the chapter on headache. The importance of a careful history with special attention to the chief complaint: its onset, duration, frequency, and associated phenomena, is stressed as being of prime importance in the successful handling of patients. As MacBryde in his introduction states: "No mechanical measures can take the place of careful consideration of the patient's complaints." One's ability to use special techniques is a minor matter in comparison to the judgment of *when* to use certain techniques. This judgment is founded upon careful history taking and interpretation of the patient's symptoms. The practitioner's judgment in such matters will be proportionate to his ability to analyze and interpret his patient as a person rather than as a set of findings.

Perhaps the best chapter for optometrists is the one by Harold G. Wolff, Associate Professor of Medicine at the Cornell University College of Medicine, on "Headache—Mechanisms and Differential Diagnosis." Dr. Wolff presents a basic anatomical and physiological analysis of the pain sensitive structures in the head and he discusses the mechanism of headaches associated with intercranial pressure, brain tumor, migraine, hypertension, anomalies of refraction and ocular motility, etc. He points out the importance of incidence, intensity, location, onset, duration, frequency, relation to muscle spasm, photophobia, periodicity, gastrointestinal disturbances, vertigo, mood, sleep, eye grounds, fever, family history, etc.

The chapter on nervousness and fatigue by Edwin F. Gildea, Professor of Psychiatry, Washington School of Medicine, should be of interest also to optometrists since these symptoms are reported frequently by patients with ocular symptoms. Dr. Gildea defines briefly the terms "nervousness" and "fatigue" and presents the pathologic physiology of

these conditions. He discusses the differential diagnosis and the involvement of mental disorders (manic depressive psychosis and psychoneurosis), as well as the neurologic conditions, the glandular disturbances, and nutritional disorders. It is important to determine the specific circumstances under which the symptoms of nervousness and/or fatigue began and the chronology of subsequent occurrences. A careful personal history is invaluable in determining the proper diagnosis and treatment.

While the other chapters (Fever, Thoracic Pain, Cough and Hemoptysis, Abdominal Pain, Hematemesis and Melena, Jaundice, Joint Pain, and Obesity) may not be of much interest to optometrists, nevertheless, the rationale and continued insistence upon a careful record of symptoms and history is instructive.

While the best instruments and techniques may measure well the patient's physical anomalies, they cannot take the place of the clinician's ability to elicit a careful history and his evaluation of the patient as a human being. Rather than rely upon the measurements of ocular aberrations and those of the visual skills—necessary and helpful as these determinations are—a complete optometric service should include a careful consideration of the patient's history and symptoms—not only to determine what ocular treatment may be necessary but, perhaps of equal importance, to determine when ocular treatment is not advisable.

ROBERT E. BANNON

IN THE DAYS OF MY YOUTH. James P. C. Southall. The University of North Carolina Press, Chapel Hill, N. C., 208 pp. Cloth. $3. 1947.

This small book conveys the memories of Professor Southall of his youth in Virginia. It is excellently written in an unpretentious and humorous vein. While it is undoubtedly a fascinating and valuable book for anyone interested in an accurate picture of the educational and social life during the post-reconstruction years in Virginia, it is of special interest to those who were fortunate enough to have been Southall's pupils or who have been influenced by his lucid writings on geometrical and physiological optics, for herein they may hear their beloved teacher speak again.

James P. C. Southall was born in Norfolk, Virginia, in 1871 but moved to Richmond at an early age where he attended McGuire's School and Richmond College. From 1888 to 1893, he attended the University of Virginia, receiving his B. A. in 1891 and his M. A. in 1893. Following teaching at various colleges and universities, he was appointed

to the faculty of Columbia University in 1914 where he remained until 1941 when he retired with the rank of Professor Emeritus of Physics. During that period he served optometry well as Director of the Professional Courses in Optometry at Columbia. Over a period of nearly 30 years, many a young man became devoted to Professor Southall for his keen and scholarly knowledge and many more are indebted to him because of his writings: "Principles and Methods of Geometrical Optics" (1910), "Mirrors, Prisms, and Lenses" (1918), "Introduction to Physiological Optics" (1937), and his translation of Helmholtz' "Physiological Optics" in three volumes (1924-25).

Those who have known Professor Southall as students cherish the memory of him as a scholar and gentleman of the old school with classical poise and dignity. He was wont to enliven his lectures with a Latin quotation but not in a manner of erudition, but rather he made one feel as though he were being spoken to man-to-man. Indeed, Professor Southall was a true friend and advisor to his students who learned not only their optics but also felt the influence of his kindly nature. In recognition of his outstanding service to optometry, as a teacher and as a scientist, Professor Southall was made an honorary Fellow in the American Academy of Optometry at the 1946 annual meeting of the Academy in Philadelphia.

Southall's memoirs related in his book "In The Days of My Youth" do not cover the years which he served as Director of the Professional Courses in Optometry at Columbia, but rather his youthful years prior to his interest in optometry. Nevertheless, this book is mentioned here to call the attention of those who may be interested in the opportunity of hearing Professor Southall speak again through the medium of the printed page and to learn about the means current in the latter part of the last century whereby a young man received his education and developed his culture.

ROBERT E. BANNON

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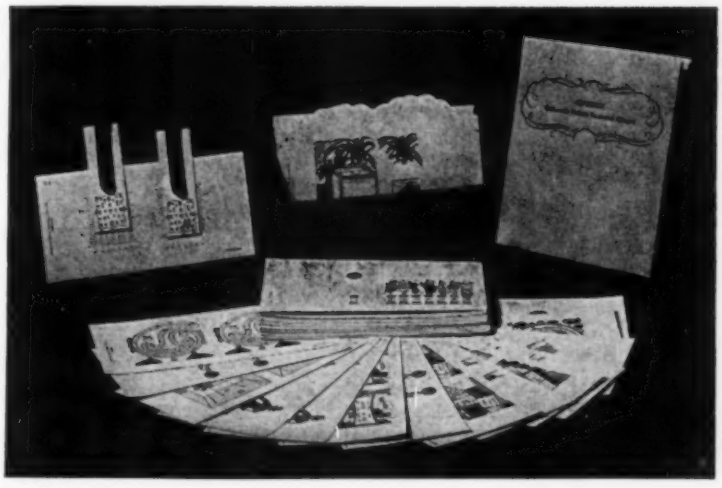

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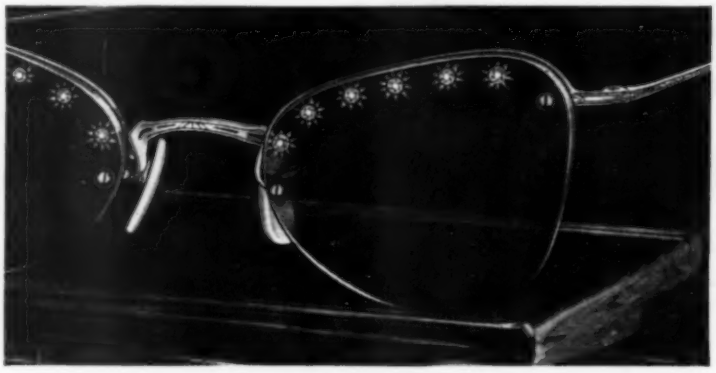

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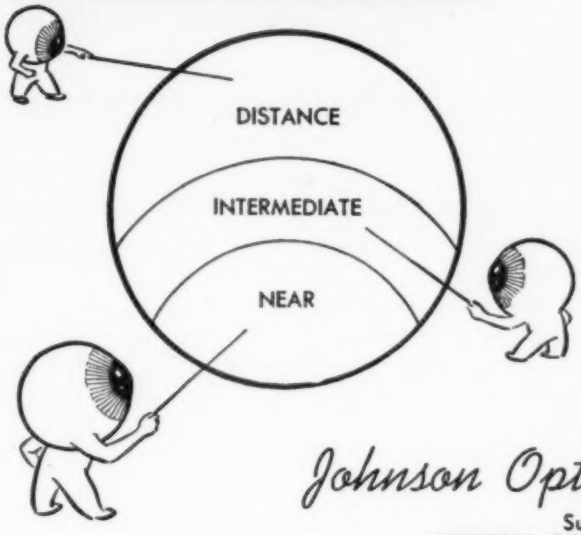

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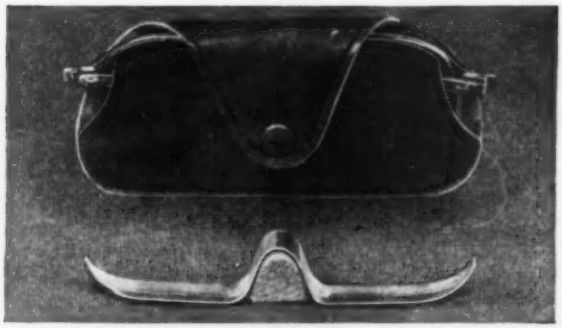

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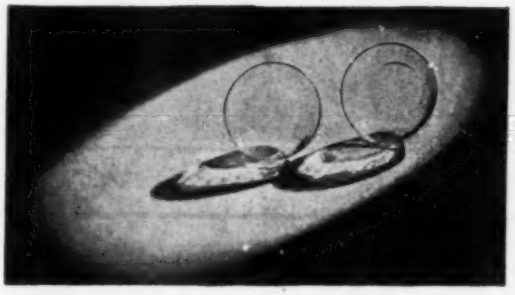

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